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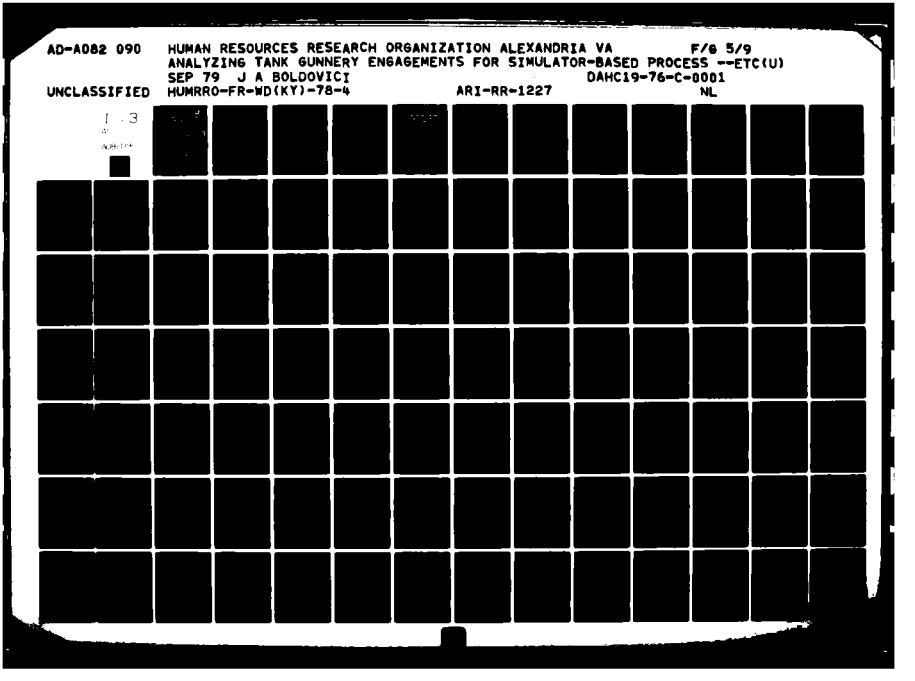

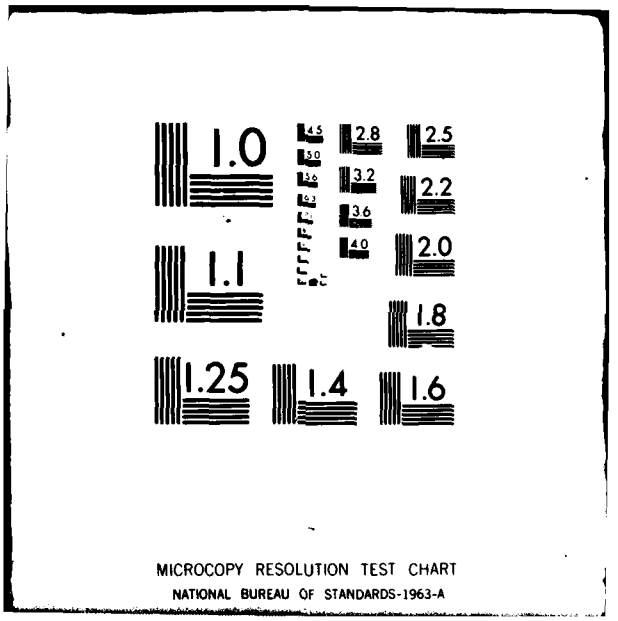

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Research Report 1227

ANALYZING TANK GUNNERY ENGAGEMENTS FOR SIMULATOR-BASED PROCESS MEASUREMENT

John A. Boldovici
Human Resources Research Organization

LEVEL II

ARI FIELD UNIT AT FORT KNOX, KENTUCKY

U. S. Army
Research Institute for the Behavioral and Social Sciences

September 1979

U. S. ARMY RESEARCH INSTITUTE FOR THE BEHAVIORAL AND SOCIAL SCIENCES

A Field Operating Agency under the Jurisdiction of the Deputy Chief of Staff for Personnel

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Automated devices can potentially measure the processes as well as results of armor crew performance. This research analyzed a sample of three tank gunnery engagements in order to (1) identify the stimuli and overt responses in a sample of gunnery tasks, (2) identify and rank-order the response groups, overt responses, and enabling skills for each duty position in the sample engagements, and (3) write prototype measurement specifications for a sample of those response groups, overt responses, and enabling skills.

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20. continued--

The decisions and overt responses of each crew member for the sampled tasks were displayed in several sets of flow diagrams. The diagramming yields immediate information for the design and use of diagnostic tests: (a) what is to be measured can be determined from inspection of the overt responses, and (b) stimulus materials can be inferred from inspection of the decisions.

Methods for sorting overt responses into groups and for inferring enabling skills were based on three considerations: perception of initiating stimuli, recall of procedures or rules, and motor behavior. These methods yielded a four-tiered behavior hierarchy for each duty position for each engagement. Measures of crewmen's performance at all levels of the hierarchy would permit (a) troubleshooting performance sequences by backtracking scores top to bottom through the hierarchy, (b) testing sequentially from bottom to top, and (c) predicting performance in higher instructional units from scores on lower units.

Measurement specifications were written for the response groups, overt responses, and enabling skills in a main gun precision engagement. Each contains: (a) a sample test scenario, from which display requirements for testing devices may be inferred; (b) a description of the responses to be measured, from which control requirements for testing devices may be inferred; (c) identification of the end-point events for measuring elapsed time; and (d) a description of how to assess the accuracy of the response of interest.

Research Report 1227

ANALYZING TANK GUNNERY ENGAGEMENTS FOR SIMULATOR-BASED PROCESS MEASUREMENT

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FOREWORD

Research in the Fort Knox Field Unit of the Army Research Institute for the Behavioral and Social Sciences (ARI) supports armor and tank gunnery training, including the development of simulators for training tank gunnery crewmen. Successful gunnery training is measured by how well the crew can hit the target (product measurement). Complex electronic simulators, however, offer the possibility of measuring crew actions during an engagement (process measurement) in order to diagnose learning problems and improve performance. Recognizing this, the ARI field unit is exploring methods of gathering the necessary data to develop automated process measurement of tank gunnery training. For this report, three tank gunnery engagements were analyzed to develop prototype measurement specifications for selected tasks for which automated process measures might be developed. The research was responsive to requirements of Army Project 2Q762722A764, Training and Education. The work was performed under Contract DAHC 19-76-C-0001 at the Fort Knox Office of HumRRO and was monitored technically by Donald F. Haggard of the ARI field unit.

JOSEPH ZEIDNER
Technical Director

BRIEF

The ease with which simulators and other electronic teaching and testing devices can be programmed to measure times between events offers new opportunities for diagnosing and improving the performance of armor crewmen. Engagement profiles could be automatically generated, showing for example, time between target appearance, initiation of fire command, onset of each crew member's response to the fire command, termination of responses, and so forth. Such profiles could be compared with ideal engagement profiles, and the observed differences between the crew's performance and the ideal used as a basis for pinpointing performance deficiencies. Analysis of objective process measures, in addition to being useful for diagnosing performance, permits:

1. Setting performance standards empirically; that is; answering questions such as, "What levels of mastery must be achieved in early instructional units to enable prediction at given confidence levels that the standards in later units will be met?"

2. Designing efficient training and testing programs, in which *demonstration* of mastery of lower units of instruction is required before trainees are allowed to proceed to higher units.

REQUIREMENT

Recognizing the potential of forthcoming electronic devices for diagnosing and improving the performance of armor crews, the U.S. Army Research Institute for the Behavioral and Social Sciences (ARI) is exploring methods that will permit automated process measurement in tank gunnery engagements.

The purposes of this research were to:

1. Identify the stimuli and overt responses comprising a sample of gunnery tasks.

2. Identify and hierarchically order response groups, overt responses, and enabling skills for each duty position in a sample of gunnery engagements.

3. Write prototypic measurement specifications for a sample of response groups, overt responses, and enabling skills.

4. Document the methods used in accomplishing the three objectives listed above.

RESULTS

Achieving the objectives listed above was described in three parts:

1. Identifying Overt Responses

2. Response Groups and Enabling Skills.

3. Measurement Specifications.

Identifying Overt Responses

A sample of three tank gunnery engagements was analyzed. The outcomes of the analysis were several sets of flow diagrams showing each crew member's decisions and overt responses. Diagramming engagements as was done here yields immediate implications for the design and use of diagnostic tests:

1. What is available for direct and indirect measurement can be inferred by inspection of the overt responses in the diagrams. A comprehensive diagnostic test would include at least a measure of the presence or absence ("did it" or "did not do it") of each overt response shown in the diagrams.

2. Stimulus materials can be inferred from inspection of the decisions in the diagrams. If, for example, the Gunner must make a decision about whether the TC has or has not said GUNNER, then a diagnostic test should include stimulus materials which require that such a distinction be made.

3. Diagnostic tests designed as suggested here could be used to pinpoint the cause of a target miss, and to decrease performance times, both by backtracking through records of the examinee's performance.

Response Groups and Enabling Skills

Methods were described for sorting overt responses into response groups, and for inferring enabling skills based on three considerations: perception of initiating stimuli, recall of procedures or rules, and motor behavior. The methods were applied to a sample of three tank gunnery engagements, yielding a four-tiered behavior hierarchy for each duty position in each engagement. Obtaining measures of crewmen's performance at all levels of the hierarchy would be useful on at least three counts:

1. Troubleshooting performance sequences, by "backtracking" through scores from top to bottom in a hierarchy.

2. Testing sequentially from bottom to top in a hierarchy, so that crewmen would be permitted to proceed to higher units of instruction only after demonstrating mastery of prerequisite lower units.

3. Predicting performance in higher instructional units from scores obtained in lower units. (A related possibility is the use of correlation to set performance standards empirically.)

Even without measures at all levels, analysis in terms of behavior hierarchies is useful because it helps identify prerequisites for each component response in a tank gunnery engagement.

Measurement Specifications

Measurement specifications were written for the response groups, overt responses, and enabling skills in a main gun precision engagement. Each specification contains:

1. A sample test scenario, from which display requirements for testing devices may be inferred.

2. A description of the responses to be measured, from which control requirements for testing devices may be inferred.

3. Identification of the events between which time is to be measured.

4. A description of how to assess the accuracy of the response of interest.

USE OF FINDINGS

Incorporating the capability for continuous time measurement in forthcoming tank simulators will require analyses and measurement specifications similar to those presented in this report. Generating the behavior hierarchies for each of the 266 tank gunnery engagements described in Boldovici, Boycan, Fingerman, and Wheaton (1978) would provide the necessary item pool from which sampling could take place for diagnostic as well as qualification testing. As in all domain-referenced testing, actually generating the item pool is not necessary. What is necessary is agreement among test constructors and users as to what the pool would look like if it were generated. In the present case, the domain would be comprised of a separate behavior hierarchy such as the ones in the appendixes of this report, for each of 266 engagements. *Sampling gunnery engagements for testing* should be done according to the methods and considerations described in recent work by Wheaton, Fingerman, and Boycan (1977).

Implementing measurement specifications such as the ones presented in this report should be straightforward if electronic devices are used. Problems may be encountered in automating the measurement of the accuracy of some responses (fire commands, for example); but these problems can be solved. Even without immediate solutions, considerable improvements over present methods of performance measurement can be achieved by continuous measurement of time between "benchmark" manipulatory responses and their initiating stimuli.

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ANALYZING TANK GUNNERY ENGAGEMENTS FOR SIMULATOR-BASED PROCESS MEASUREMENT[1]

The uses and benefits of process measurement seem not to be widely appreciated. Why this is so is not entirely clear. Two reasons seem plausible, however. One is that the increased use of criterion-referenced tests in the military has been accompanied by emphasis on product, rather than process measurement; that is, emphasis on direct measurement of ultimate as opposed to intermediate outcomes (U.S. Army[2]). In armor circles, for example, one hears such sentiments as, "I don't care how they (tank crews) do it, as long as they get steel on the target." This minimizing of concern with how it is done also is reflected in methods of scoring Table VIII: Speed, accuracy, and ammunition conservation are the only dimensions on which crews are scored. Measures of mediating behavior or products--sight pictures, for example, or speed and accuracy of fire commands--are not routinely made.

Another possible reason is that many process measures are difficult to obtain. Even if one would like to have, for example, measures of the time between target appearance, initiation of fire command, onset of each crew member's response to the fire command, termination of responses, and so forth, it is hard to imagine how such measures would be gotten as a part of routine crew testing. The picture that comes to mind is one of an "efficiency expert," stopwatch in one hand, clipboard in the other, getting in the crew's way, all for the sake of obtaining unreliable measures. Difficulties like these will disappear with increasing use of simulators and electronic testing devices. Such devices can easily be programmed to measure time between events, and (less easily) to measure the accuracy of crewmen's responses. Given the measurement capability of electronic devices, two questions immediately arise:

1. To what uses can the capability be put? (Or, less elegantly, "What good is it?")

---

[1]The work reported here was performed under Contract No. DAHC 19-76-C-0001 with the U.S. Army Research Institute for the Behavioral and Social Sciences. The author is grateful for the assistance of Richard E. O'Brien, who provided subject-matter expertise in analyzing gunnery engagements; Ronald E. Kraemer, Donald M. Kristiansen, and David W. Bessemer, who suggested revisions in drafts of this report; and the COTR, Donald F. Haggard, who provided suggestions for conceptualizing problems and solutions throughout the project.

[2]Army, Department of the, Training Support Center, Guidelines for the Development of Skill Qualification Tests. Fort Eustis, Virginia: Author, 1977.

2. How does one develop requirements that can be used in designing simulators and devices for process measurement?

Before addressing these questions, a digression seems advisable, to define exactly what is meant by process and product measurement, and to examine their effects on performance evaluation.

Distinguishing between process measurement and product measurement is confusing. The difference obviously is not in the measure. One cannot tell whether 2.5 cm is a process or a product measure any more than one can tell whether 2.5 cm is a measure of the radius or the diameter of a circle. If not by inspection of measure, how is the distinction to be made? It can be made along at least four dimensions. All writers are not in agreement as to which dimensions should be used (compare, for example, Osborn[1] with Army[2]), and some writers switch from one dimension to another, without acknowledging the implications of having done so. (See, for example, Osborn,[1] and Swezey and Pearlstein[3]). The four dimensions along which the process-product distinction is made involve measuring:

1. By observation of behavior, as opposed to some trace ("product") of behavior. Guidance for developing Skill Qualification Tests[2,4] is unequivocal in distinguishing between process-scoring and product-scoring depending on whether,

   > ... the scorer observe[s] ... the task performance or ... some product produced during performance of the task (2, p. 4.7).

   The distinction seems reasonable and is easy to apply. Its adoption has not been widespread.

2. Performance of tasks which do not generate "products" as opposed to tasks which do. Osborn,[1] and Swezey and Pearlstein[3] referring to Osborn's work, distinguish

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[1]Osborn, W.C. Process Versus Product Measurement in Performance Testing. San Antonio, Texas: Paper presented at Military Testing Association, 1973.

[2]Army, Department of the, Training Support Center, op. cit., 1977.

[3]Swezey, R.W., and Pearlstein, R.B. Guidebook for Developing Criterion-Referenced Tests. Arlington, Virginia: U.S. Army Research Institute for the Behavioral and Social Sciences, 1975.

[4]Campbell, R.C., Ford, J.P., and Campbell, C.H. Development of a Workshop on Construction and Validation of Skill Qualification Tests. Alexandria, Virginia: Human Resources Research Organization (HumRRO), 1978.

between tasks in which the process is the product (close-order drill and diving, for example), and tasks in which the product always follows correct performance of the process (packing a parachute, for example). Osborn[1] also notes, "Relatively few tasks are of the first type--those in which the product and the process are the same." Indeed, one might argue that no tasks are of the first type. Diving is no more the product of diving than parachute-packing is the product of parachute-packing. If a packed parachute is the product of packing a parachute, then a splash in the water must be the product of diving. The difference between the tasks is not that the product is the process in one and not in the other. Rather, one difference is in the concreteness or permanance of parachutes as compared to splashes--a difference with no compelling implications for measurement, because it is easily eliminated by the use of photography or other means of making permanent records. A more important difference is that one can, with a minimum of practice, inspect parachutes and make useful inferences about the quality of task performance, but cannot inspect splashes and make very useful inferences about diving. This difference inheres, not in the tasks themselves, but in our ignorance about the relations between task outcomes and performance quality. Where little or no special knowledge is required to relate outcomes to performances, performances typically are judged on the basis of outcomes. Footraces are examples. Where special knowledge is required (and absent), we relegate performance assessment to judges and critics. Evaluating diving, concerts, and gymnastics are examples.

3. For diagnosis, as opposed to certification. Osborn,[1] in describing the uses of process and product measurement, introduces a distinction based on test purpose:

> ... measures which focus on task outcomes (products) normally provide data relevant to the first purpose [certification], whereas measures of how tasks are carried out (process) pertain to the second [diagnosing instructional weaknesses] (p. 1).

This is a variant of another dimension for making the distinction; namely, a means-end dimension.

---

[1]Osborn, W.C., op. cit., 1973.

4. Means, as opposed to ends. Since processes and products are roughly analogous to means and ends, viewing all measures of means as process measurement, and all measures of ends as product measurement seems reasonable. The means-end dimension is useful because it implies the need to specify objectives: without objectives, one cannot determine whether means or ends have been measured.

Distinguishing between process and product measurement is not difficult if the measured event or product falls at the same end of all four dimensions. If, for example, a measure is made by direct observation of performance of a task which has products from which inferences cannot be made about performance quality, and the measure is used diagnostically, and the task is a means to an end, then one is clearly dealing with a "process" measure. Confusion arises, however, when a measured event or product falls near opposite ends of any two dimensions. Suppose for example that measures taken from a sight photograph were used diagnostically. The SQT experts would say that product measurement had taken place, because observation was not made of performance. The measures would, however, qualify as process if the diagnosis-qualification dimension were used. Whether the measures were of means or ends would depend on the stated objective: means (process) if the objective were to hit a target, ends (product) if to lay crosshairs on an aiming point.

Despite apparent confusion about appropriate dimensions for distinguishing between process and product measurement, the distinction seems useful. It is useful because it reflects a concern with objective, as opposed to subjective measurement and evaluation. If evaluation can be defined as making judgments based on comparisons between expected or desired characteristics of behavior or a product of interest, and observed characteristics of the same behavior or product, then it seems to follow that the more precisely stated the expectations and the more objective the observations, the better the evaluation. This line of thinking underlies current testing emphases: stating objectives and standards (expectations) on the one hand, and objectively measuring performance (or "products" of the performance) on the other. Standards can be well defined, loosely stated, or not defined or stated at all. Examples near the extremes are, "At least one target hit with two rounds," and "neutralizes targets at various ranges." Similarly, behavior or product characteristics can be measured precisely, measured imprecisely, or measured not at all. Examples near the extremes are measuring length with a ruler and estimating casualties. Evaluation improves with the extent to which it consists of comparing measured characteristics of behavior or products with well defined standards.

Figures 1 and 2 present examples of kinds of evaluations which result from various combinations of precision and imprecision in standards on the one hand, and measurement or estimation of behavior or products on the other. The upper left cell in both figures is the most desirable from the standpoint of good evaluation. Here measured characteristics are compared with well defined standards. When a physician says, "Your pulse rate is high," we have confidence in this evaluation because (a) the physician has measured our pulse rate objectively, (b) the standard is clearly defined (72-80 beats per minute), and (c) the rules for making a judgment of high or low are obvious. For the same reasons we have confidence in evaluations of tensile strength (Figure 2, upper left cell.)

The upper right cells inspire less confidence, but retain the virtue of well defined standards. Estimates rather than measures of behavior or product characteristics are used here, probably for expediency, and could, with added cost, be replaced by measurement: A photograph could be made of the pass receiver and the boundary line (Figure 1), and instruments could be used to measure front-end play in the car (Figure 2). Comparing the results of the photographs or of the instrument readings with available standards for "out-of-boundness" or the need for front-end work would increase our confidence in the evaluation.

The bottom cells of the two figures are of interest mainly as areas to be avoided by serious evaluators. In the lower left cells the evaluator makes precise measures of the behavior or product of interest, and compares these with a standard which is loosely or not defined. "Evaluations" of mental health and of stereo equipment, for example, involve very precise measurement of many behavior and product characteristics whose relevance to a behavior or product standard cannot be known because the standard itself is not known.

In the last (bottom right) cells the evaluator compares the results of no measurement with a nonexistent or ill-defined standard. This of course is the realm of opinion and sophistry.

Perhaps the most interesting aspect of Figures 1 and 2, however, is that good evaluation is not the result of whether process (behavior) or product (trace of behavior) has been measured. It is rather a joint function of objectivity[1] in measuring the product

[1]Other characteristics of good measurement and evaluation--reliability, comprehensiveness, relevance of measures, and validity of standards, for example--have not been addressed, since the point is simply to show that the process-product distinction is of little importance in defining good measurement and evaluation.

		BEHAVIOR CHARACTERISTICS	
		Measured	Estimated
BEHAVIOR STANDARD	Well defined	Comparing observed with normal heart rate.	Referee calling a pass receiver out of bounds.
	Loosely or not defined	Evaluating a patient's mental health based on results of diagnostic tests.	Judging ice-skating, diving, dancing.

FIG. 1. Four kinds of process evaluation.

		PRODUCT CHARACTERISTICS	
		Measured	Estimated
PRODUCT STANDARD	Well defined	Comparing measured tensile strength with design specifications.	Deciding whether a car needs front end work by shaking its wheels.
	Loosely or not defined	Consumer-oriented tests of stereo equipment, TV, washing machines, etc.	Judging a painting or a novel.

FIG. 2. Four kinds of product evaluation.

or behavior, and precision in stating standards. As the bottom cells in Figures 1 and 2 clearly show, bad product measurement and evaluation are just as feasible as bad process measurement and evaluation.

The elusive distinctions between process and product measurement notwithstanding, a method for distinguishing between measurement of means and measurement of ends seems desirable. Process measurement will therefore be used arbitrarily in this report to mean measurement of the accuracy or the latency of any individual or collective behavior of the members of tank crews which occurs between the appearance of a target and a second-round miss or the strike of a round on the target. This intermediate behavior is viewed as a process or set of processes whose objective is the impact of a round on a target. Some of the intermediate behavior generates "products" with little or no observer intervention; a chambered round, for example, may be viewed as the product of the intermediate behavior, "loading." Some of the intermediate behavior generates "products" only with observer intervention. A photograph of a sight picture, for example, is the product of observer intervention in the intermediate behavior, "lays crosshairs on target." Whether intervention is or is not required to generate evidence ("products") of task performance is irrelevant to the definition of process measurement as used here. All that is required to qualify as a process measure is that the measure be made on some aspect of crew members' behavior or its outcome, which precedes a second-round miss or the strike of a first or second round on a target.

The most obvious use of objective process measurement is for diagnosing and improving skilled performance. Measures of "steel on target" are of no more use for this purpose than are final scores for diagnosing and improving the performance of football players, or measures of distance for diagnosing and improving the performance of shot-putters. The use of computer-mediated diagnostic measurement is epitomized in the work of Ariel (in Moore[1]), who has developed computer programs for comparing motion pictures of olympic atheltes' performance with models of ideal performance: A routine diagnosis of discus-thrower Mac Wilkens' performance, for example, led to an immediate improvement of 13.5 feet over his best previous throw, and nearly 6 feet greater than the existing world record. Similar applications are foreseeable with computer-based simulators for tank crewmen: Permanent records (not necessarily motion pictures) of crewmen's performance in engagements could be automatically generated, beginning with target appearance and marking each overt response of each

[1]Moore, K. "Gideon Ariel and His Magic Machine" in Sports Illustrated, 1977, 52-60.

crewman on a time line. Such profiles could be compared to models of ideal engagement profiles, and the observed differences between the crew's performance and the ideal used to pinpoint performance deficiencies. Or the same end could be achieved by comparing the profiles of high-proficiency and low-proficiency crews. The first step in the design of computer-mediated diagnosis of crewmen's performance is, of course, identifying each overt response of each crewmen in a given engagement, and the stimuli which initiate these responses. The stimuli and responses serve as inputs for generating models of ideal performance, and are the engagement "benchmarks" which the simulator must detect and record. The diagnostic measurement capability undoubtedly can be "tacked on" to devices designed primarily for teaching. But considerable savings will be realized if the engagement profiles are generated and the benchmark stimuli and responses specified before hardware designs are cast in concrete.

A second, less obvious use of objective process measurement is in the design of efficient testing sequences: Beginning with analyses of engagements which lead to identification of crewmen's overt responses and the stimuli on which the responses are contingent, one can infer enabling skills for the performance of each overt response. The stage is thus set for constructing hierarchically ordered tests to assess crewmen's mastery of enabling skills, overt responses, and engagements. (As will be seen later, testing at a fourth "level" also is feasible and desirable--a response-group level, between the overt-response and engagement levels.) Such hierarchically ordered tests promote efficiency and quality-control in training, by requiring crewmen to demonstrate mastery at a given level in the hierarchy before proceeding to the next higher level. Efficiency also is promoted by the use of such tests with novices to pinpoint exact areas where training emphasis is needed on the one hand, and would be wasteful on the other.

With tests of the kind envisioned above, a third use of objective process measurement becomes apparent: the systematic collection and analysis of test results permit predictive research, which can answer questions about the relation between mastery of one unit of instruction and another--questions such as, "Given mastery of a particular loading speed early in training, what is the probability of achieving a given engagement speed later in training?" Or, in a more practical variation of the same theme, "What levels of mastery must be achieved in early instructional units to enable prediction at given confidence levels that the standards in later units will be met?" This is principally a matter of data analysis, which can occur only after the necessary tests are designed, administered, and scored. Because such analyses will not be required for

a very long time, and because they have been described elsewhere[1], they will not be treated in this report.

RATIONALE

Recognizing the potential of forthcoming electronic devices for diagnosing and improving the performance of armor crews, and for increasing training efficiency, the U.S. Army Research Institute for the Behavioral and Social Sciences (ARI) is exploring methods that will permit automated process measurement in tank gunnery engagements. The work reported here is part of that research.

PURPOSE

The purposes of this research were to:

1. Identify the stimuli and overt responses comprised by a sample of gunnery tasks.

2. Identify and hierarchically order response groups, overt responses, and enabling skills for each duty position in a sample of gunnery engagements.

3. Write prototypic measurement specifications for a sample of response groups, overt responses, and enabling skills.

4. Document the methods used in accomplishing the three objectives listed above.

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[1]For details of analytic procedures, see Boldovici, J.A., and Osborn, W.C. Continuation of Tank Systems Skills and Training Structure (Proposal). Fort Knox, Kentucky: Human Resources Research Organization (HumRRO), 1977.

IDENTIFYING OVERT RESPONSES

The *sine qua non* for performance measurement of any kind is identifying overt responses. These or their products, and associated stimuli, serve as the signals for beginning and ending measures of accuracy and time. Before work began on identifying overt responses, however, decisions had to be made about sampling tasks for analysis, and about methods of analysis.

SAMPLING TASKS

Establishing the generality of the methods used here would require applying them to a sample of tasks which is representative of the population of tasks whose performance will be assessed using forthcoming tank simulators. The population of simulator-tested tasks should, in turn, be representative of tasks which are critical to success in combat. There are, unfortunately, no fully satisfactory ways to establish either the "representativeness" of combat tasks or their criticality to success in combat. The reason for this is, of course, that the full range of tasks that will be performed in combat cannot be known until the combat occurs.[1]

Given the difficulty of establishing representativeness, and the impossibility of establishing criticality to success in combat, a decision was made early in the project not to waste time trying to do so. Rather, the task sample would be limited to engagements similar to those in USAARMS Table VIII.[2] The inclusion of an engagement in Table VIII seems indicative of fair agreement among policymakers as to its criticality. Representativeness was addressed to the extent that one of each of three kinds of engagements was selected for analysis: battlesight, precision, and 50 caliber.

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[1]The issues involved in establishing the representativeness and the criticality of combat tasks are examined in Development of A Model Tank Gunnery Test (Wheaton, Fingerman, and Boycan, 1977), and in Criticality and Cluster Analyses of Tasks for the M48A5, M60A1, and M60A3 Tanks (Boldovici, Harris, Osborn, and Heinecke, 1977).

[2]Army, Department of the, Hq. Tank Gunnery (Field Manual No. 17-12). Washington, D.C.: Author, 1977.

ANALYSIS

An alternative was desired to what frequently passes for task analysis; that is, an alternative to listing tasks without reference to initiating stimuli, decisions, or performance sequences. A method of analysis was desired which would permit:

1. Easy identification of overt responses, since these would be the main candidates for measurement.

2. Identification of decisions associated with each overt response, as a means of inferring stimulus conditions for testing. If, for example, a Gunner must decide whether the ballistic computer is ON or OFF before making the overt response of turning the computer ON or indexing range, then the conditions under which he is tested should include a simulation of whether the computer is ON or OFF.

3. Identification of stimulus conditions for testing. These stimulus conditions ideally would be identifiable as to source or kind, because the implications for hardware design may be different depending on whether the stimuli which initiate an overt response are generated by another crew member, for example, as compared to some features of the external environment.

4. Identifying performance sequences, since sequences have obvious implications for testing.

5. Producing consistent results among analysts, as for example, by the use of highly structured formats and a parsimonious vocabulary.

A method which meets the first four of the requirements listed above was used. Inter-analyst consistency (item 5 above) was not examined, though the method does use a structured format and few words. The method was simply to diagram each of the three sample engagements in terms of binary (yes-no) decisions and overt responses. A separate diagram was prepared for each crew member involved in each of the sample engagements.

RESULTS

Figure 3 presents the diagram for the Gunner's decisions and overt responses in a precision engagement against a stationary tank at 500 to 4400 meters, using SABOT or HEAT, from a firing vehicle moving to a halt. (This corresponds to USAARMS engagement VIII 4D.) Decisions are shown in diamonds, overt responses in ovals. Triangles (NTE = not this engagement) indicate terminuses for "unallowable" decisions. In Figure 3, for example, NTE appears at the end of the NO branch for "TC Announce Ammo?" The NTE triangle simply indicates that the Gunner is "not allowed" to decide that the TC has not announced ammo in the diagrammed (precision) engagement.

The sequence in Figure 3 begins with the overt response of looking for targets. The first decision is whether or not a particular feature of the environment is a possible target. If it is not, then the Gunner continues looking for targets. If it is, then he must decide whether the possible target is indeed a target (as oppposed to a friendly). If not, he continues looking. If so, the next decision is whether the target is a tank. If not, the analysis (which is for an engagement against a stationary tank) does not apply. If the target is in fact a tank, the Gunner says TANK and announces its position. The analysis continues until the TC either issues the command, FIRE, or indicates that he will perform the engagement by saying FROM MY POSITION. Similar diagrams were prepared for the remaining duty positions (TC, Loader, Driver) in the precision engagement, and for the duty positions in a battlesight and 50 caliber engagement, corresponding respectively to engagements 2ad and 1D (50) in Table VIII. The diagrams are presented in Appendixes A, B, and C.

DISCUSSION

The decision-response diagrams for the three engagements raise several points for discussion. These points concern the operations involved in diagramming, and the implications of the diagrams for diagnostic testing.

Operations in Diagramming

A question naturally arises as to why some decisions are shown in the diagrams and others are not. Discriminating between possible targets and targets, for example, and discriminating between tanks and other targets, were shown as decisions in Figure 3; discriminating between the target's position and other positions was not. The

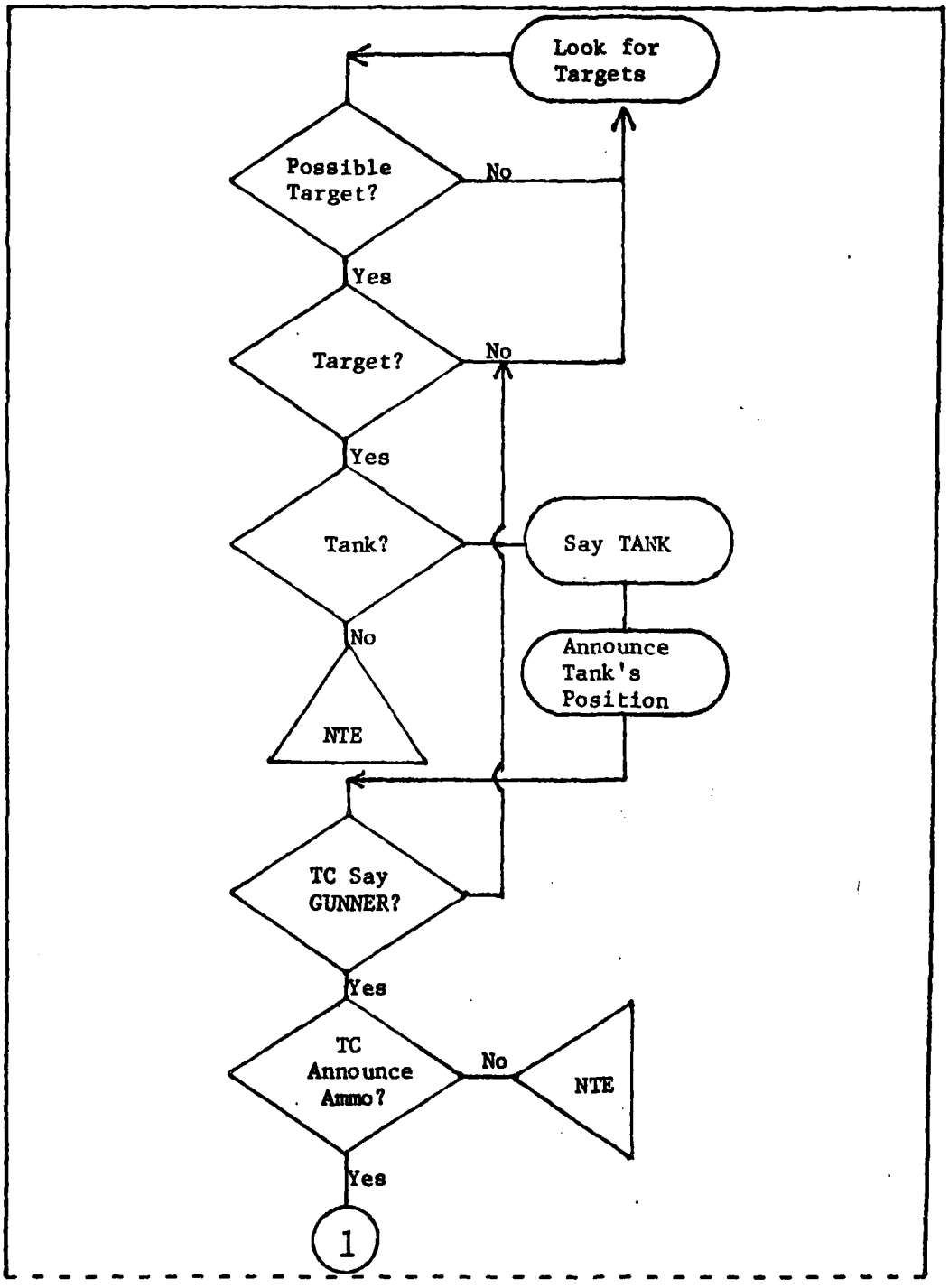


FIG. 3. Gunner's decisions and responses in a precision engagement against a stationary tank at 500 to 4400 meters, using SABOT or HEAT, from a firing vehicle moving to a halt.

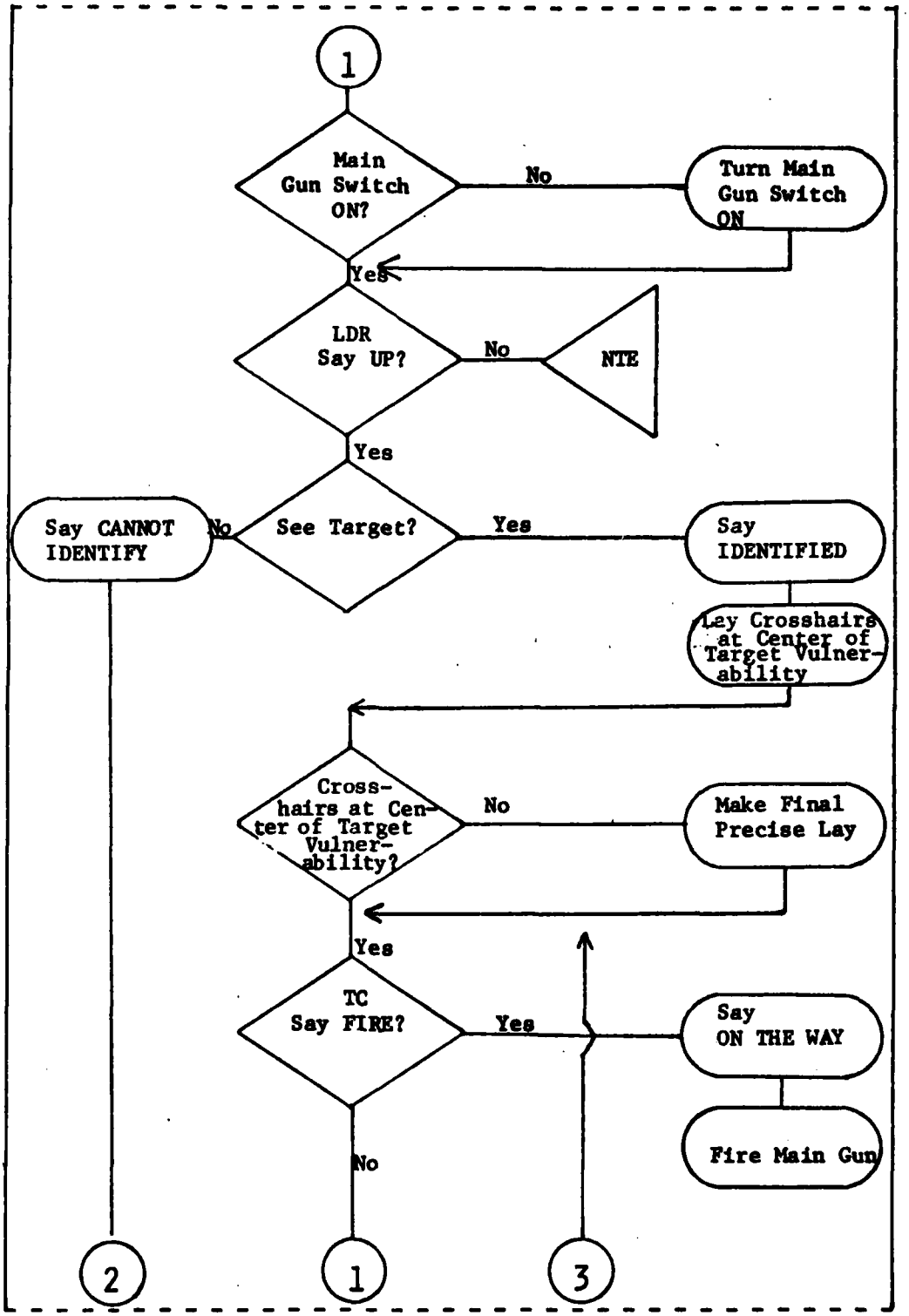


FIG. 3 (Continued). Gunner's decisions and responses in a precision engagement against a stationary tank at 500 to 4400 meters, using SABOT or HEAT, from a firing vehicle moving to a halt.

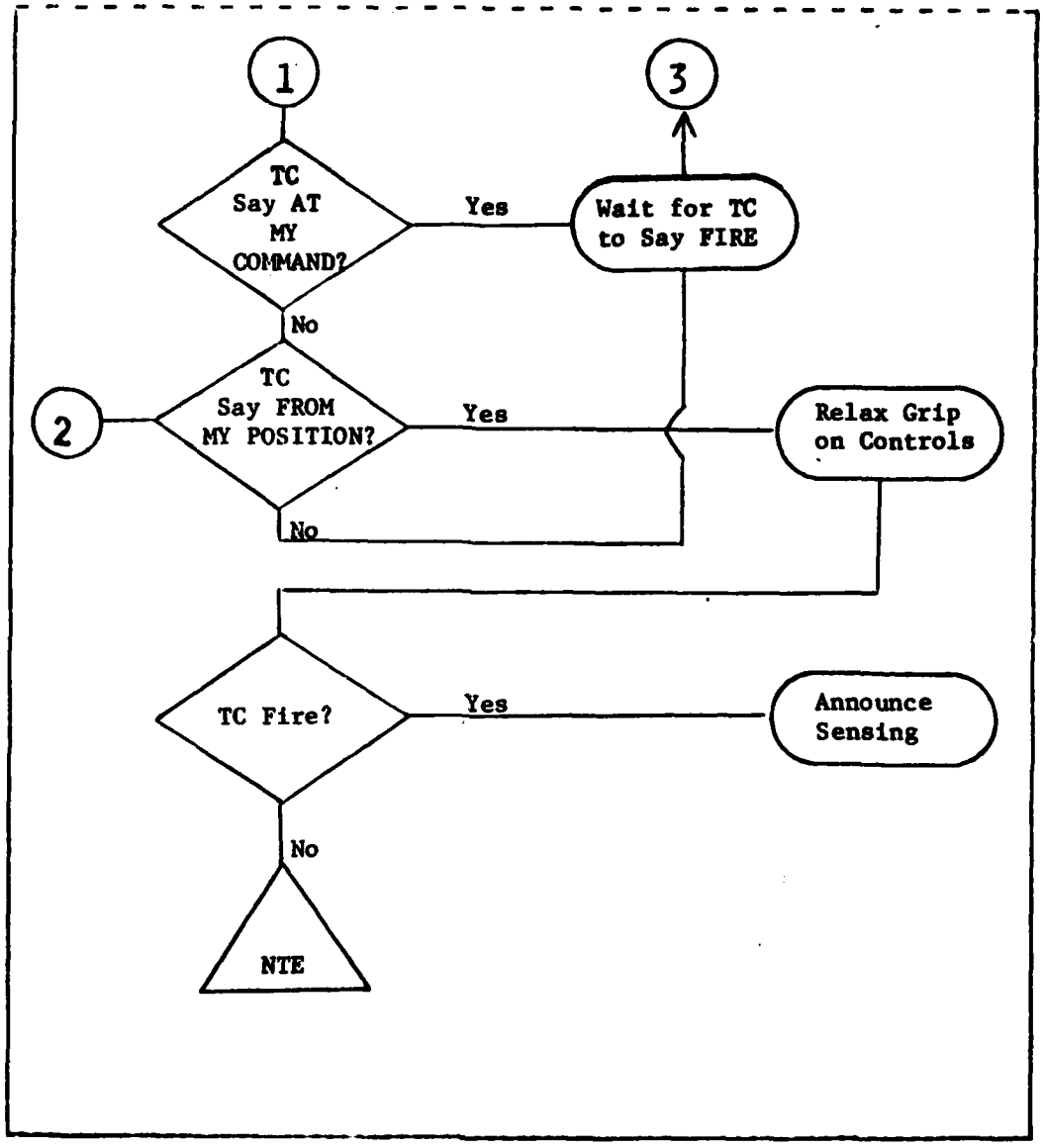
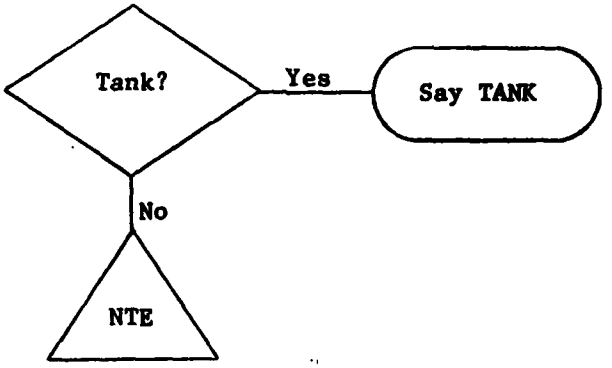
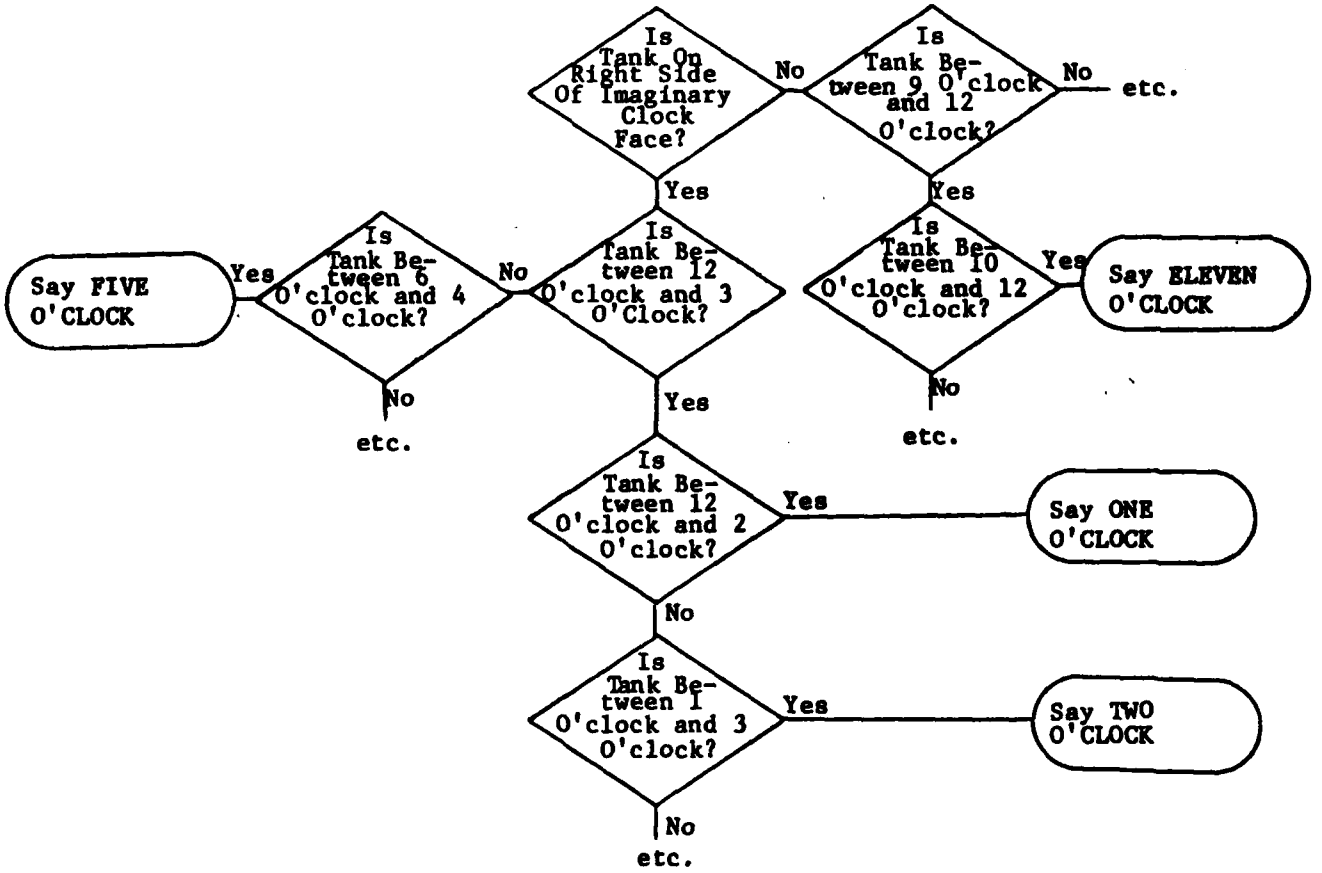


FIG. 3 (Continued). Gunner's decisions and responses in a precision engagement against a stationary tank at 500 to 4400 meters, using SABOT or HEAT, from a firing vehicle moving to a halt.

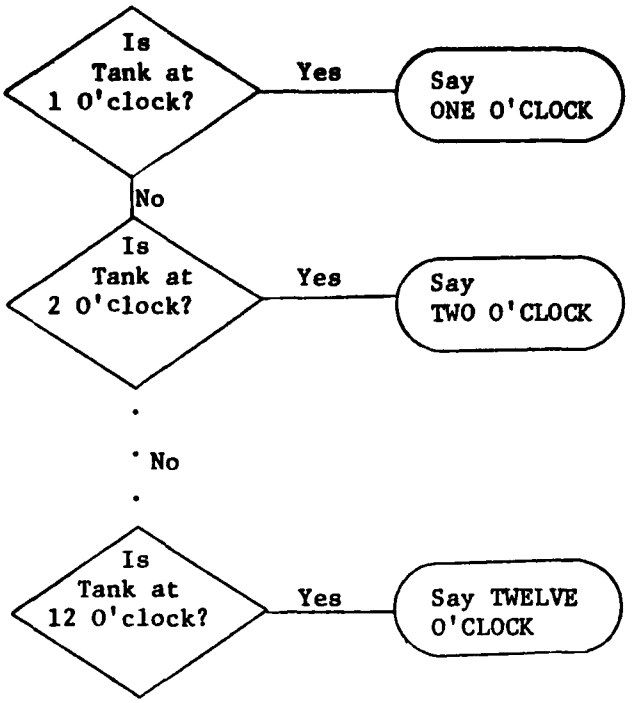
reason for this inconsistency lies partly in the descriptors used for characterizing the engagements, and partly in the desire to keep the diagrams simple. Since it is given (in the title of Figure 3) that the target is a tank, diagramming the decision is a simple matter requiring only that the discrimination between tank targets and other targets be shown. Thus:



The tank's position, however, is not given in the engagement description. Representing the position in the diagram would therefore require showing, not a binary discrimination between the given position and all other positions, but a series of decisions. Thus:



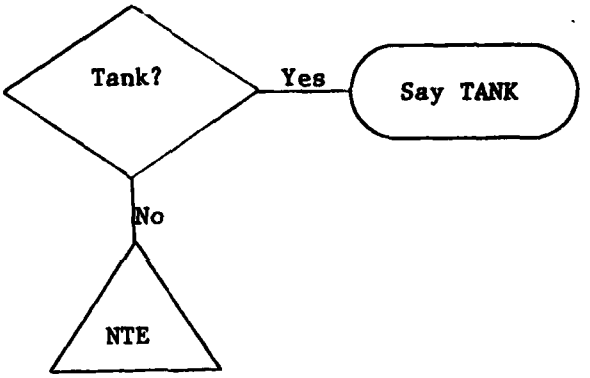
Or (more parsimoniously):



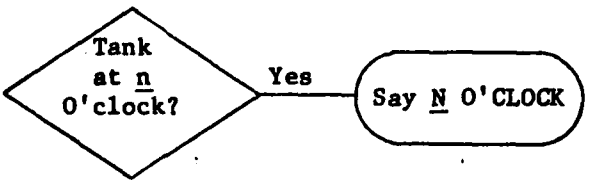
To have included decisions series such as the ones shown above would have lengthened and complicated the diagrams considerably. And little would have been gained by doing so. The chief gain would have been in showing that announcing target position required an enabling skill; namely, the ability to discriminate among target positions in terms of positions on an imaginary clock face. This inference is easily made without the drudgery of diagramming "decisions" about each of the twelve positions on a clock face, or of drawing and diagramming split-half methods for depicting the process by which one zeroes in on target position--a process which fits the binary decisions model quite well, but undoubtedly is at odds with the reality of matching target positions with positions on an imaginary clock face. Because the inference about enabling skills is easily made without diagramming the decision series, a decision was made early in the project not to diagram such series. Rather, a step entitled "Infer enabling skills," would be inserted in the test-development procedures which follow. That is, for each overt response shown in the diagrams, an attempt would be made as part of the development of test specifications, to infer the enabling skills on which performance of the overt response depended. The commitment to this decision, however, immediately raised two questions:

1. If one can examine some overt responses and make inferences about enabling skills, why not do the same for all overt responses? That is, simply list overt responses without diagramming the decisions on which they are dependent, and infer enabling skills later?

2. Why not, in the dual interests of consistency and simplicity, show all prerequisite skills as simple binary decisions? Diagram those decisions that could be represented as binary by reference to the engagement description as was done; that is:



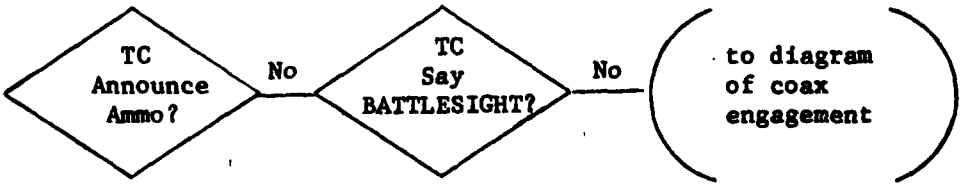
and diagram those decisions that could not be represented as binary by reference to the engagement description in some general form; for example:



The second option listed above seems reasonable, at least at first glance. Notice though, that no decision is really involved in "deciding" whether a tank is at n o'clock: all tanks have to be somewhere. The "decision" cannot therefore have a NO branch. And if this is the case, there is little point in representing the "decision" in the diagram. Simply showing the overt response, "Announce position," (or "Say N O'CLOCK) is sufficient.

The first question raised above is well taken. There is nothing sacred about diagramming engagements. Doing so simply permits identification of overt responses, inferences about enabling skills and stimulus conditions for testing, and identification of performance sequences--normal sequences and, as will be seen later, emergency sequences as well. The structured format which results from diagramming also seems to help reviewers identify errors, and should promote inter-analyst consistency. If methods can be devised which are less time consuming than diagramming, and which produce the same results, they should be used.

The NTE triangles also warrant discussion. As noted earlier, they indicate terminuses for unallowable decisions. Recall that in Figure 3, NTE appeared at the end of the NO branch for "TC Announce Ammo?" because in the diagrammed (precision) engagement, the Gunner was not allowed to decide that the TC had not announced ammo. If the TC must announce ammo, however, then one could argue that no decision is required by the Gunner as to whether the TC has announced ammo. The decision block (and the associated NTE triangle) could be eliminated from the diagram. Notice also that the Gunner's overt response which follows the "TC announce ammo?" "decision" is "Turn main gun switch ON"--a response which is initiated, not by whether the TC's announcing ammo, but by the main-gun switch's being in the OFF position. A case might be made, therefore, for eliminating the ammo decision block (and its associated NTE triangle) on two grounds: it does not represent a decision, and the Gunner's next response is not dependent on it. Why then were the blocks with NTE terminuses included? They were included for two reasons. In some cases (the one being discussed here, for example) they help distinguish the depicted engagement from other possible engagements. This is, of course, redundant information in a diagram for any single engagement, which may be easily distinguished from any other engagement by its title. But testing overt responses within a single engagement hardly constitutes a comprehensive gunnery test. One also would like to test crewmen's ability to use information in fire commands for distinguishing among engagements. The diagram in Figure 3 represents just one small part of the gunnery-engagement domain. If the entire domain were mapped, the NTE triangle would be replaced by additional decision blocks leading to parts of the domain corresponding to other engagements; for example:



Thus some of the NTE triangles indicate where other engagements would "hook up" to the diagrammed engagement were we to diagram the entire gunnery domain. Notice, however, that not all NTE triangles indicate hookup points for diagrams of other engagements. On the second page of Figure 3, for example, an NTE triangle ends the NO branch for "LDR Say UP?" There is no normal engagement in which the TC would say GUNNER, the TC would announce ammo, the Gunner would turn the main gun switch ON, and the Loader would not say UP. If the Loader did not say UP, it would be because something had gone wrong. Thus, the second reason for including the NTE triangles: some of them indicate points where a procedure other than the routine or ideal one would have to be applied. Such points might be used to indicate methods for testing armor crewmen in the same way that deliberate stalls or instrument malfunctions are used in testing pilots. Such points might even indicate gaps in doctrine or S.O.P. (What, for example, are the TC's and Gunner's S.O.P. when, in a main gun engagement, the Loader does not say UP?)

Testing Implications

The main implication of the diagrams for diagnostic testing is in the overt responses. A fully diagnostic test of the Gunner's performance in the engagement in Figure 3, for example, would minimally include ascertaining whether or not the Gunner looked for targets, whether or not he said TANK and announced its position, whether or not he turned the main gun switch ON, and so forth. This is not to say that overt responses are the only candidates for process measurement, or that the only way to measure performance is by direct observation of overt responses. Human behavior is, in some cases, contemplative or "mental," having no overt responses naturally associated with it. Recalling the number of tanks in a platoon is an example. In other cases, natural or criterion overt responses may be difficult or expensive to measure in situ. Responses associated with distinguishing HEAT from other main gun rounds are examples. In both cases, test developers contrive stimuli (items) that require examinees to make responses which would not be made in performing criterion or "real-world" tasks, but which are taken as evidence of ability to perform the criterion tasks: Circling the number 5 in a multiple choice test is widely regarded as evidence of recalling the number of tanks in a platoon, for example, as is circling a picture of a HEAT round for distinguishing between HEAT and other rounds; despite the fact that tank crewmen do not, in the course of normal engagements, draw circles around numbers and pictures. Identifying criterion overt responses thus provides a starting point not only for testing by direct observation, but also for developing and judging the relevance of indirect measurement where direct measurement is not possible or efficient.

Another implication for diagnostic-test design appears on inspection of the diamonds, which suggest enabling skills. The first diamond in Figure 3, for example, requires Gunners to distinguish between possible targets and other environmental features. A diagnostic test should do this also. Similarly, in the second diamond the Gunner must distinguish between targets and "non-targets." The diagnostic test should require that such distinctions be made. Similar lines of reasoning can be applied to the remaining diamonds in the diagram.

Notice too that the contents of the diamonds indicate areas where team testing may be appropriate; that is, areas where the overt response of one crew member is the stimulus for the response of another crew member. Figure 3, for example, shows several Gunner's responses (in ovals) which are initiated by elements of the TC's fire command (in diamonds). This is not to say that such responses should necessarily be tested in a team context. In fact, simulations of fire commands and other verbal stimuli are preferable from the standpoint of standardization and reliability. If one were interested in a global of test of TC and Gunner performance, however, or of total crew performance, the diagrams could be used to determine which stimuli and responses should be produced by whom.

Implications about the uses of a diagnostic test incorporating features such as those suggested above also deserve mention. Consider two cases in which diagnosis would be warranted: the Gunner fires and misses; or he fires and hits, but exceeds the time standard. In the first case (missing), diagnosis would proceed by working backwards from a record of the oval, "Say ON THE WAY, and fire main gun." Did the Gunner make a final precise lay? Did he lay the crosshairs at the center of target vulnerability? A "no" answer to either question would pinpoint the problem. (A "yes" answer to both would indicate an equipment problem.)

In the second case (firing, hitting, but exceeding the time standard), the diagnostician would simply play the role of efficiency expert, comparing the times between the Gunner's overt responses or between stimuli and overt responses, with a set of optimal or ideal times. Such comparisons would permit ascertaining, for example, whether too much time was taken between laying the crosshairs at the center of the target vulnerability, and the TC's saying FIRE; or between the TC's saying FIRE and the Gunner's saying ON THE WAY and firing.

SUMMARY

A sample of three gunnery engagements was analyzed. The outcomes of the analysis were several sets of diagrams, the main components of which are diamonds showing crew members' decisions and ovals showing overt responses. Diagramming engagements as was done here yields immediate implications for the design and use of diagnostic tests:

1. What is available for direct and indirect measurement can be inferred by inspection of the ovals (overt responses) in the diagrams. A comprehensive diagnostic test would include at least a measure of the presence or absence ("did it" or "did not do it") of each overt response shown in the diagrams.

2. Stimulus materials can be inferred from the decision diamonds. If, for example, the Gunner must make a decision about whether the TC has or has not said *GUNNER*, then a diagnostic test should include stimulus materials which require that such a distinction be made.

3. Diagnostic tests designed as suggested here could be used to pinpoint the cause of a target miss, and to decrease performance times, both by "backtracking" through records of the examinee's performance.

The design of simulators to permit diagnostic testing as suggested here should not be particularly difficult. Ascertaining the presence or absence, and the time between responses (or between the end of a stimulus and the end of an associated response) is well within the state of the art. A comprehensive "time-line" system is feasible, which senses four kinds of events--beginning of stimulus, end of stimulus, beginning of response and end of response--and which automatically records the time between each successive pair of events.

While generating fire commands and other auditory stimuli, and measuring elapsed time seem entirely feasible, problems are likely to be encountered in generating visual stimuli for such responses as "look for targets." Digital image generation seems promising and will be increasingly used as studies of predictive validity become available.

RESPONSE GROUPS AND ENABLING SKILLS

The overt responses discussed in the preceding section represent but one behavior "level" at which performance measurement might take place. At least three other levels are conceivable. The most obvious is the engagement level, at which Table VIII measurement occurs. Between the engagement and overt-response level is at least one other, which might be called the "response-group" level. "Gives fire commands" is an example of a TC response group, which is comprised of the overt responses, "Say GUNNER," "Say BATTLESIGHT TANK," "Say AT MY COMMAND," and so forth. Since making overt responses depends on certain enabling skills, yet another level of behavior emerges: the enabling-skill level. The TC's overt response "Say GUNNER," for example, subsumes enabling skills such as "Distinguishes between targets and friendlies," and "Distinguishes between Gunner and TC targets." Thus one can envison a structure of armor crew behavior comprised of four levels: engagement, response group, overt response, and enabling skill. An example of such a structure is shown in Figure 4.

Analysis and measurement in terms of tiers or hierarchies such as the one shown in Figure 4 are, as suggested earlier, useful for several reasons. One may, for example, troubleshoot performance sequences by analysis of scores from top to bottom in the hierarchies. Or one may design efficient tests and training by working from bottom to top; that is, by requiring trainees to master the lower tiers before allowing them to proceed to higher ones. Finally, systematic collection of data at all levels in the hierarchy would permit precise estimates of the probabilities of passing higher units based on scores obtained in lower units.

Troubleshooting the performance sequences of armor crewmen, designing efficient tests, and predicting performance levels have not been feasible in the past, not only because of high costs, but also because the equipment necessary for automated process measurement has been unavailable, and because task analyses for armor crewmen typically do not order behavior hierarchically. The use of computer-based simulators for teaching and testing armor crews will open the door to automated process measurement. To use these measurement capabilities fully, however, requires analyses in addition to those used in generating the decision-response diagrams. The additional analyses would lay the groundwork for measurement at four levels: the engagement level, at which measurement currently is being done; the overt-response level discussed earlier; and a response-group and enabling-skill level.

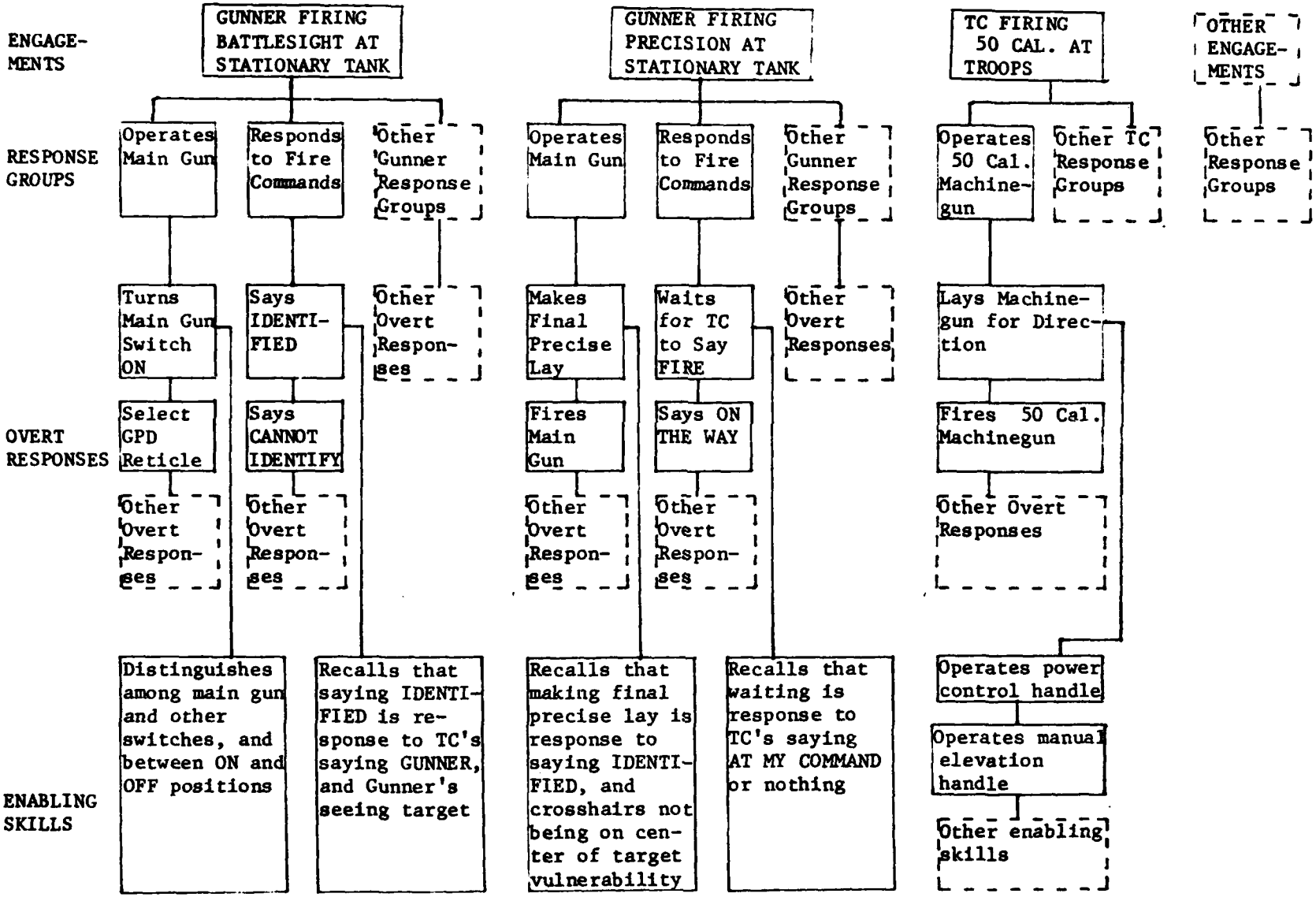


FIG. 4. Example of four-tier behavior hierarchy.
(Details in Appendixes D, E, and F.)

PURPOSE

The purpose of this part of the study was to identify the response groups and enabling skills for each duty position in the sample engagements, and to describe the methods for doing so.

METHOD

The method for identifying response groups was straightforward: the overt responses identified earlier were simply sorted into groups reflecting apparent functional similarities. The Gunner's overt responses, "Turns main gun switch ON," and "Fires main gun," for example, were sorted into a response group which was labelled, "Operates main gun," as were responses associated with the use of fire-control instruments.

The method for inferring enabling skills for each overt response was to consider three things:

1. Perception of the stimuli that initiate the response.
2. Recall of procedures or rules on which correct responding is contingent.
3. Motor behavior involved in making the response.

If any of these three things was judged to require more than one trial for mastery, it was listed as an enabling skill for the response under examination. If there was a doubt as to whether one trial was sufficient for mastery, the enabling behavior was included rather than excluded. Distinguishing between the ON and OFF positions of the main gun switch, for example, was listed as an enabling skill for operating the main gun, though some would argue that only one trial would be required for mastering the distinction. Examples of enabling skills in each of the three classes listed above are shown in Figure 5.

Notice that the "fit" of each example in Figure 5 is by no means unequivocal. Distinguishing between tanks and other targets, for example, could be changed from a perception of initiating stimuli to recall of rules or procedures by rewording such as, "Recalls that all tanks are characterized by turrets, road wheels, and tracks." The important point, however, is not that the enabling skills be

OVERT RESPONSES	ENABLING SKILLS	
	KINDS	EXAMPLES
Say TANK, and announce its position	Perception of initiating stimuli	. Distinguishes between targets and friendlies. . Distinguishes between tanks and other targets.
Turn Main Gun switch ON	Recall of procedures or rules	. Recalls that turning Main Gun switch ON is response to: . TC's saying GUNNER and the name of a Main Gun round, and . Main Gun switch's being in OFF position.
Lay cross-hairs at center of target vulnerability	Motor behavior	. Operate Gunner's Day Periscope.

FIG. 5. Examples of three kinds of enabling skills for a Gunner in a precision engagement.

labelled correctly, but that they be included. The labels simply provide a convenient way of thinking about enabling skills when trying to infer them from overt responses.

RESULTS

Figure 6 presents the overt responses (two-digit Arabic numerals) identified as described earlier, sorted into response groups (one-digit Arabic numerals), and augmented with enabling skills (three digits), for a Gunner in a precision engagement against a stationary tank at 500 to 4400 meters, using SABOT or HEAT, from a firing vehicle moving to a halt. Similar analyses were done for the remaining duty positions (TC, Loader, Driver) in the precision engagement, and for the duty positions in a battlesight, and a 50 caliber engagement. The results are presented in Appendixes D, E, and F.

1. Acquires targets
   - 1.1. Look for targets
     - 1.1.1. See entries under 1.2 below for enabling skills.
   - 1.2. Say TANK, and announce its position
     - 1.2.1. Distinguishes between prospective targets and other environmental features.
     - 1.2.2. Distinguishes between targets and friendlies.
     - 1.2.3. Distinguishes between tanks and other targets.
     - 1.2.4. Describes locations of objects in terms of position on a clock face.
     - 1.2.5. Recalls that target's position must be announced immediately after saying TANK.

2. Operates main gun
   - 2.1. Turn main gun switch ON
     - 2.1.1. Distinguishes among main gun and other switches, and between ON and OFF positions, in response to various fire commands.
     - 2.1.2. Recalls that turning Main Gun switch ON is response to:
       - . TC's saying GUNNER and the name of a main gun round, and
       - . Main Gun switch being in OFF position.
   - 2.2. Lay crosshairs at center of target vulnerability
     - 2.2.1. Recalls that laying crosshairs at center of target vulnerability is response to:
       - . TC's announcing GUNNER and main gun ammunition, and
       - . GNR's saying IDENTIFIED.
     - 2.2.2. Operates Gunner's Day Periscope.
     - 2.2.3. Recalls location of center of target vulnerability.
   - 2.3. Make final precise lay
     - 2.3.1. Recalls that making final precise lay is response to:
       - . Saying IDENTIFIED, and
       - . Crosshairs' not being on center of target vulnerability.
     - 2.3.2. Operates power control assembly.
   - 2.4. Fire main gun
     - 2.4.1. Recalls that firing is response to saying ON THE WAY.
     - 2.4.2. Recalls procedure for firing.

FIG. 6. Examples of response groups, overt responses, and enabling skills: Gunner, precision engagement with periscope.

3. Responds to fire commands
   3.1. Say IDENTIFIED
      3.1.1. Recalls that saying IDENTIFIED is response to:
         . TC's saying GUNNER, and
         . Seeing the target, and
         . LDR's saying UP.
   3.2. Say CANNOT IDENTIFY
      3.2.1. Recalls that saying CANNOT IDENTIFY is response to:
         . TC's saying GUNNER, and
         . Not seeing the target.
   3.3. Say ON THE WAY
      3.3.1. Recalls that saying ON THE WAY is response to:
         . Crosshairs' being on center of target vulnerability, and
         . TC's saying FIRE.
   3.4. Wait for TC to say FIRE
      3.4.1. Recalls that waiting is response to TC's saying:
         . AT MY COMMAND, or
         . Nothing.
   3.5. Relax grip on controls
      3.5.1. Recalls that relaxing grip is response to TC's saying *FROM MY POSITION*.
   3.6. Announce sensing
      3.6.1. Recalls that sensing round is response to TC's firing.
      3.6.2. Recalls procedure for sensing round.

FIG. 6 (Continued). Examples of response groups, overt responses, and enabling skills: Gunner, precision engagement with periscope.

DISCUSSION

Several aspects of the results in Appendixes D, E, and F deserve mention. One is the high degree of redundancy across engagements at the response-group level. The major groups across engagements are "Acquires targets," "Gives fire commands," "Responds to fire commands," "Operates Main Gun," "Fires Main Gun." The redundancy is not surprising, but suggests that sampling engagements for analysis need not be a great concern, at least at the response-group level: for a given crewman and weapon, the response groups are likely to be independent of the particular engagements sampled.

The analyses of the sample engagements also provide a means for ordering instruction. Mastery of the behavior shown at each level in the hierarchy is prerequisite for mastery at the next higher level. It is important from both a training and a testing standpoint to note that the behavior is not simply additive as one proceeds up a path in the hierarchy: mastery of a lower level is necessary but not sufficient for mastery at the next higher level. A Gunner could, for example, master all the enabling skills involved in a battlesight engagement, and still not be able to perform at the overt-response level. This is so because at the overt-response level, performance depends not only on mastery of the enabling skills, but also on deciding which skills are to be used under what conditions. The implications for measurement are clear: as one proceeds up the hierarchy, one is not measuring the "same things." Rather, some higher levels require the integration of skills mastered at lower levels, other higher levels require selecting from among skills mastered at lower levels, and discrimination among the stimuli which initiate performance of the skills. This is as it should be in the design of a comprehensive, hierarchically ordered process measurement system:

> ". . . the end-of-course test should supplement rather than duplicate the segment tests given while training proceeds. If a given task that is taught in the course is presented in three separate pieces during the learning process, for example, the final test should contain a measure of proficiency on the task as a whole, and not check once again each of the pieces."[1]

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[1]Schwarz, P.A., and Boldovici, J.A. Operating a Training Quality Control System. Pittsburgh, Pennsylvania: American Institutes for Research, 1971.

A final noteworthy aspect of the behavior hierarchies in Appendixes D, E, and F is the preponderance of the behavior--especially at the enabling-skill and overt-response levels--which is verbal. Such behavior probably is easily learned and validly tested using extremely "low-fidelity" simulations. As will be seen in the next section, one advantage of analyzing engagements as was done here is that doing so permits strong inferences about minimally sufficient test media for each response group, overt response, and enabling skill.

SUMMARY

Methods were described for sorting overt responses into response groups, and for inferring enabling skills based on three considerations: perception of initiating stimuli, recall of procedures or rules, and motor behavior. The methods were applied to a sample of three tank gunnery engagements, yielding a four-tiered behavior hierarchy for each duty position in each engagement. Obtaining measures of crewmen's performance at all levels of the hierarchy would be useful on at least three counts:

1. Troubleshooting performance sequences, by "backtracking" through scores from top to bottom in a hierarchy.

2. Testing sequentially from bottom to top in a hierarchy, so that crewmen would be permitted to proceed to higher units of instruction only after demonstrating mastery of prerequisite lower units.

3. Predicting performance in higher instructional units from scores obtained in lower units. (A related possibility is the use of correlation to set performance standards empirically.)

Even without measures at all levels, analysis in terms of behavior hierarchies is useful because it leads to discovery of prerequisites for each component response in a tank gunnery engagement.

MEASUREMENT SPECIFICATIONS

Use of the methods described in the two preceding sections led to identification of behavior hierarchies for several tank gunnery engagements. Identifying the components of a behavior hierarchy does not, however, lead automatically to measurement specifications from which simulator or testing device requirements may be inferred. At least one more developmental step is required which identifies the contexts (stimulus conditions) within which behavior at the various levels is to be performed and observed, and which specifies dimensions of the behavior for measurement. The specifications of stimulus conditions and measurement dimensions define the display, control, and recording requirements for test devices, and provide the starting point for hardware and software design.

PURPOSE

The purpose of this part of the study was to write measurement specifications for a sample of response groups, overt responses, and enabling skills; and to describe the methods for doing so.

METHOD AND RESULTS

Measurement specifications were written for each response group, overt response, and enabling skill, for each crew position in a main gun precision engagement. The specifications are presented in Appendix G. One of the measurement specifications, for the TC's enabling skill, "Distinguishes between Targets and Friendlies," is presented as an example in Figure 7. Here it can be seen that the specification has two major sections, one entitled "Sample Test Scenario," and the other, "Measurement." The Sample Test Scenarios specify stimuli which can be expected to elicit the desired responses. The stimuli include instructions to the examinee, and in some cases, test materials. As will be seen on inspection of Appendix G, no materials are specified in many cases, especially at the enabling skill level. These cases are knowledge items, in which the examinee responds to direct questioning by the test administrator. The only materials necessary are for recording responses.

The section of the specifications entitled, "Measurement," is divided into three parts. The first pertains to performance time, and simply specifies an event and the response between which time is to be recorded. (The initiating events and the responses are underscored.) The next part of "Measurement" pertains to

PRE TC: 2.1.2. DISTINGUISHES BETWEEN TARGETS AND FRIENDLIES

SAMPLE TEST SCENARIO

- TC overlooking simulation of rolling, partly wooded terrain is instructed to monitor his area of surveillance, and to say TARGET in response to targets, and nothing in response to friendlies.

- Five moving targets and 5 moving friendlies appear on terrain which contains 5 stationary targets and 5 stationary friendlies, singly and in likely combinations, in random order, at the ranges given in the table below, within a total of 2 min, at various positions within the TC's area of surveillance, at various angles of regard.

	T	F
M	<400m 400-799 800-1199 1200-1599 1600-1999	<400m 400-799 800-1199 1200-1599 1600-1999
S	<400 400-799 800-1199 1200-1599 1600-1999	<400 400-799 800-1199 1200-1599 1600-1999

T = target, F = friendly, M = moving, S = stationary. Ranges in meters.

MEASUREMENT

- Mean time (in sec) between appearance of targets and TC's saying TARGET.

- Accuracy, as indicated by the response TARGET to targets, and by saying nothing in response to friendlies.

- Max = 20 = 10 announcements of TARGET + 10 silences.

FIG. 7. Measurement specification for TC's enabling skill, "Distinguishes Between Targets and Friendlies."

accuracy--the extent which the emitted response or its result approximates an ideal or perfect response or result. Difficulties in measuring the accuracy of many responses involved in tank gunnery will be discussed later. The third part of "Measurement" is simply the maximum number of correct responses the examinee can make, given the conditions specified in the test scenario.

DISCUSSION

The measurement specifications provide a basis for inferring simulator design chacteristics. Display requirements can be derived from the test scenarios, and control requirements from inspection of the desired responses. The dimensions and metrics in the specifications are explicit with respect to requirements for measuring time and accuracy, and for counting correct and incorrect responses. The various parts of the specifications do, however, raise several points for discussion.

Sample Test Scenarios

The objective in developing scenarios such as the ones presented in Appendix G is to permit the design of tests that are efficient; that is, tests that yield acceptable validity at least cost. Since validity cannot be established in advance, several aspects of developing the scenarios were, of necessity, arbitrary. Consider, for example, the number of test stimuli in Figure 7. The specification calls for ten targets and ten friendlies to appear singly and in likely combinations. One would, of course, like to specify target arrays and other initiating stimuli associated with performance having high predictive validity. Establishing the predictive validity for tests of combat performance is impossible. A compromise or "fallback" position is therefore required in test design. Such a position is provided by trying to achieve content validity. Thus, the target arrays for the enabling performance in Figure 7 would be presented in combinations and frequencies reflecting best guesses about likely enemy arrays. A platoon or section of Warsaw Pact tanks, for example, is more likely to be encountered than is a single enemy tank, which in turn is more likely to be encountered than combinations of Warsaw Pact and NATO tanks. Estimates about likely threats may be found in FM 30-40,[1] Wolfe,[2] and several TEC lessons (020-171-0201, -0202, -0203).

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[1]Army, Department of the, Hq. Handbook on Soviet Ground Forces. (Field Manual No. 30-40). Washington, D.C.: Author, 1975.

[2]Wolfe, T.W. Soviet Power and Europe. Baltimore, Maryland: Johns-Hopkins Press, 1970.

Because of the considerations noted above, the sample scenarios should be regarded as just that--samples. They do not by any means represent the entire item domain for each enabling skill, overt response, and response group. This point became clear during developing many of the verbal items for the enabling skills (three-digit numbers) in Appendix G: wherever test instructions are involved, test outcomes are likely to be influenced by subtleties in language. Testing the Loader on noticing a difference between a round named in a fire command and a previously loaded round provides a case in point. One may cast the item in terms of a generality: "The TC has begun a fire command, in which the named ammo is different from the round in the chamber..."; or one may cast it as an example: "The TC has begun a fire command by saying GUNNER SMOKE. SABOT is in the chamber." Another item-form problem involves cue recency or salience: The Loader can be asked, "What do you do next?" (where "next" is the last word he hears). Or he can be asked, "What is the next thing you do?" (where "next" is buried in the middle of the question). Yet another problem involves amount of cuing: "What do you do after placing a round in a ready rack?" for example, as opposed to, "You have unlocked a ready rack, unloaded a main gun round, and put it in a ready rack. What do you do next?" What effect, if any, alternate items and item forms will have on test outcomes cannot, unfortunately, be determined in advance. These are empirical issues whose resolution must await analysis of test scores. Test development is an iterative process in which tryouts are conducted and revisions made in the pursuit of economy and validity. The sample test scenarios provide starting points for conducting the necessary research.

Performance Time

Performance time measurement for each response group, overt response, and enabling skill, is given as the mean time between an initiating stimulus and an observable response. A question naturally arises as to whether timing should begin with initiation or termination of the stimulus, and whether timing should end with initiation or termination of the response. The minimal measurement requirement should be time from termination of stimulus to completion of response. One might also measure the time between termination of the stimulus and initiation of response, if the interest is in separating "information processing time" from motor performance time.

Accuracy

As noted earlier, difficulties will be encountered in measuring the accuracy of many of a crew's responses. Objective measurement

of the accuracy of a fire command would, for example, require the use of metrics which reflected the number and order of words in the command, and its intelligibility. Automation of such measurement probably is within the state of the art, but development, programming, and hardware costs might be prohibitive. Two alternatives to direct measurement of accuracy are apparent. The first is to shift the focus for observation from the fire command itself to the response for which the fire command serves as a stimulus, and to assume that if the response occurs then the fire command was adequate. Two problems arise, however: the response of interest may occur in the absence of any fire command at all; and if the response fails to occur, one will not know whether the failure was due to the performance of the "responder," or of the person who gave the command.

Another alternative to direct measurement of accuracy is to relegate measurement to the opinions of judges. Doing so does nothing to solve the measurement problem, of course, but if two or more judges can independently agree that a fire command was or was not adequate, then direct measurement may not be necessary. The use of human observers, however, seems contrary to the spirit of electronic simulation, the main virtue of which is the ability to supplant the vagaries of expert opinion with objective measurement and recording.

Scoring

An attempt was made throughout the specifications to separate the issue of weighting (assigning points for various performances) from the issue of scoring, (the proportion of correct to possible correct responses). Problems can be avoided by extreme care in defining correct responses. In laying the rangeline on the center of target vulnerability, for example, will an error of one mm be tolerated? Ten mm? Similarly, will the center of target vulnerability be defined as a point or a circle? And if a circle, of what diameter? Answering such questions may seem trivial, but is necessary to objective, automated scoring.

Scoring is in all cases to be based on the number of correct and possible correct responses. The reason for this can be explained by example. Assume that five targets (Warsaw Pact) and five NATO tanks appear at various ranges and in various combinations within the area of surveillance of a TC, whose task is to name each as a target or a friendly. The TC produces the following results:

1. Calls four of the five targets "targets."
2. Calls one of the five targets "friendly."

3. Calls four of the five friendlies "friendly."

Scoring could be done according to at least three formulas:

1. $\frac{C}{I+C} = \frac{8}{9} = .89,$

2. $1 - \frac{I}{C} = 1 - 1/8 = .875,$

3. $\frac{C}{\text{possible } C} = \frac{8}{10} = .80,$

where C = number of correct identifications,
and I = number incorrect.

Formulas 1 and 2 are not recommended. They take into account correct and incorrect responses, but do not reflect the TC's failure to identify one of the five friendlies. Formula 3, because it takes into account omissions as well as correct and incorrect identifications, is recommended.

Additional Development

While some problems may be encountered in implementing measurement specifications such as the ones presented here--especially in automating the measurement of response accuracy--these problems can be solved. Even without immediate solutions to accuracy measurement problems, considerable improvements over present methods of measuring armor crewmen's performance can be realized. Many of a crew's responses require manipulating equipment. Such responses can be used to provide signals to electronic timing devices. Continuous measurement and recording of time between these "benchmark" manipulatory responses and their initiating stimuli would provide the basic data for troubleshooting and improving the performance of time-constrained gunnery tasks in a way that has previously been impossible.

Incorporating the capability for continuous time measurement in forthcoming tank simulators will require analyses and measurement specifications for engagements in addition to those presented in this report. Generating the behavior hierarchies for each of the 266 tank gunnery engagements described in Boldovici, Boycan, Fingerman, and Wheaton[1] would provide the necessary item pool from

[1]Boldovici, J.A., Boycan, G.G., Fingerman, P.W., and Wheaton, G.R. Tank Gunnery Data Handbook (Draft). Alexandria, Virginia: U.S. Army Research Institute for the Behavioral and Social Sciences, 1978.

which sampling could take place for diagnostic as well as "qualification" testing. As in all domain referenced testing, actually generating the item pool is not necessary. What is necessary is agreement among test constructors and users as to what the pool would look like if it were generated. In the present case, the domain would comprise a separate behavior hierarchy such as the ones in the appendixes to this report, for each of 266 engagements. Sampling gunnery engagements for testing should be done according to the methods and considerations described in recent work by Wheaton, Fingerman, and Boycan.[1]

SUMMARY

Measurement specifications were written for the response groups, overt responses, and enabling skills in a main gun precision engagement. Each specification contains:

1. A sample test scenario, from which display requirements for testing devices may be inferred.

2. A description of the responses to be measured, from which control requirements for testing devices may be inferred.

3. Identification of the events between which time is to be measured.

4. A description of how to assess the accuracy of the response of interest.

Implementing measurement specifications such as the ones presented in this report should be straightforward if electronic devices are used. Problems may be encountered in automating the measurement of response accuracy, but these problems can be solved. Even without immediate solutions, considerable improvements over present methods of performance measurement can be achieved by continuous measurement of time between "benchmark" manipulatory responses and their initiating stimuli.

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[1]Wheaton, G.R., Fingerman, P.W., and Boycan, G.G. Development of a Model Tank Gunnery Test (Draft). Alexandria, Virginia: U.S. Army Research Institute for the Behavioral and Social Sciences, 1977.

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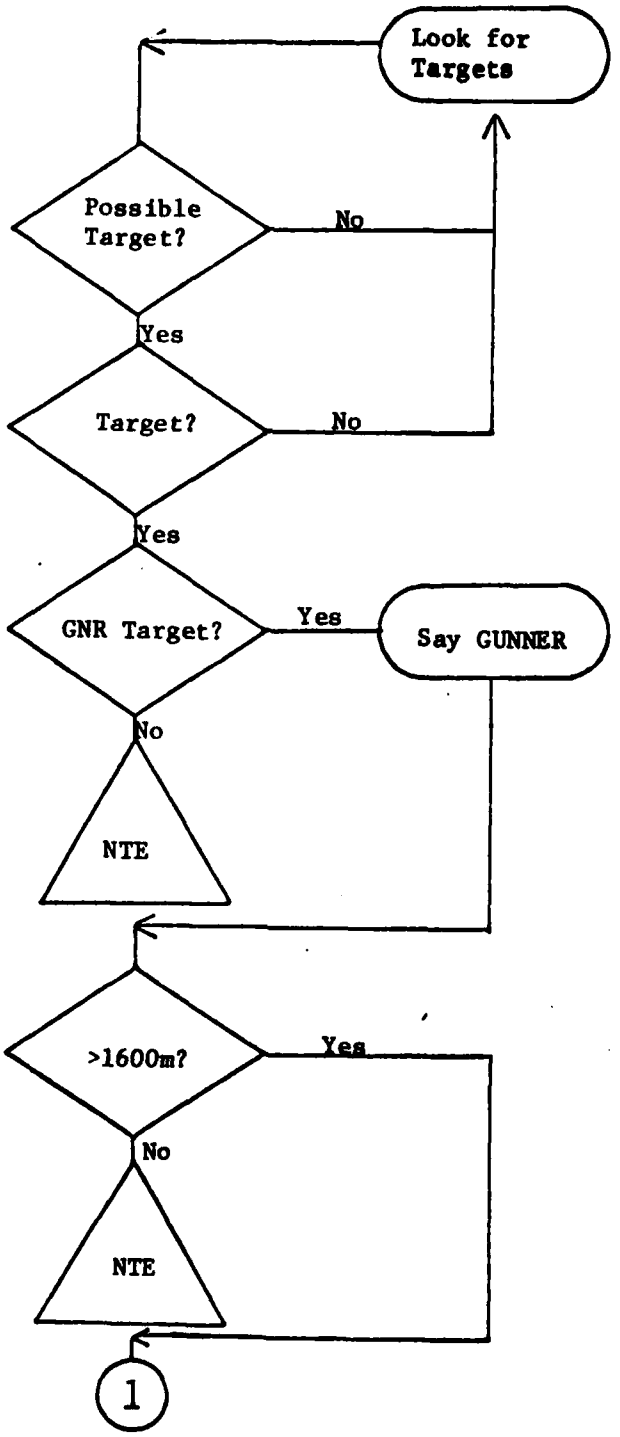
APPENDIX A

DECISION-RESPONSE DIAGRAMS FOR TC, GUNNER, DRIVER, AND LOADER: PRECISION ENGAGEMENT (GUNNER FIRING FROM TANK MOVING TO A HALT AT A STATIONARY TANK TARGET, VISIBLE WITHOUT ARTIFICIAL LIGHT AT 500 TO 4400 m., USING GUNNER'S DAY PERISCOPE AND SABOT OR HEAT)

NOTE: In preparing the decision-response diagrams for the precision engagement, and the test specifications (Appendix G) based on these diagrams, certain assumptions were made for the purpose of comprehensiveness in measurement. The net effect of the assumptions was to have crewmen doing more than they might do in a routine (Table VIII) precision engagement. The assumptions pertain mainly to target acquisition and loading:

Target acquisition. The decision-response diagram for the TC shows the TC making the initial acquisition and announcing GUNNER. The diagram for the Gunner in the same engagement shows the Gunner making the initial identification, and announcing TANK and target position. This contradictory set of circumstances was introduced so that the Gunner, as well as the TC, would get tested on acquisition and identification. The measurement specifications for the Gunner's acquiring targets (Appendix G) also may be used for Loaders and Drivers.

Loading. Deciding on test conditions for unloading is a recurring problem. If the Loader is simply told to unload, the test does not tap the self-initiating aspect of the task; namely, recognizing the conditions under which unloading is supposed to take place. To test the Loader's ability to recognize these conditions requires having the Loader load, having some time elapse, and then having the TC issue a fire command which contains the name of a round that is different from the name of the chambered round. The Loader's decision-response diagram therefore shows an unloading and reloading sequence that is initiated by the Loader's recognition that the round given in the fire command is different from the round in the chamber.



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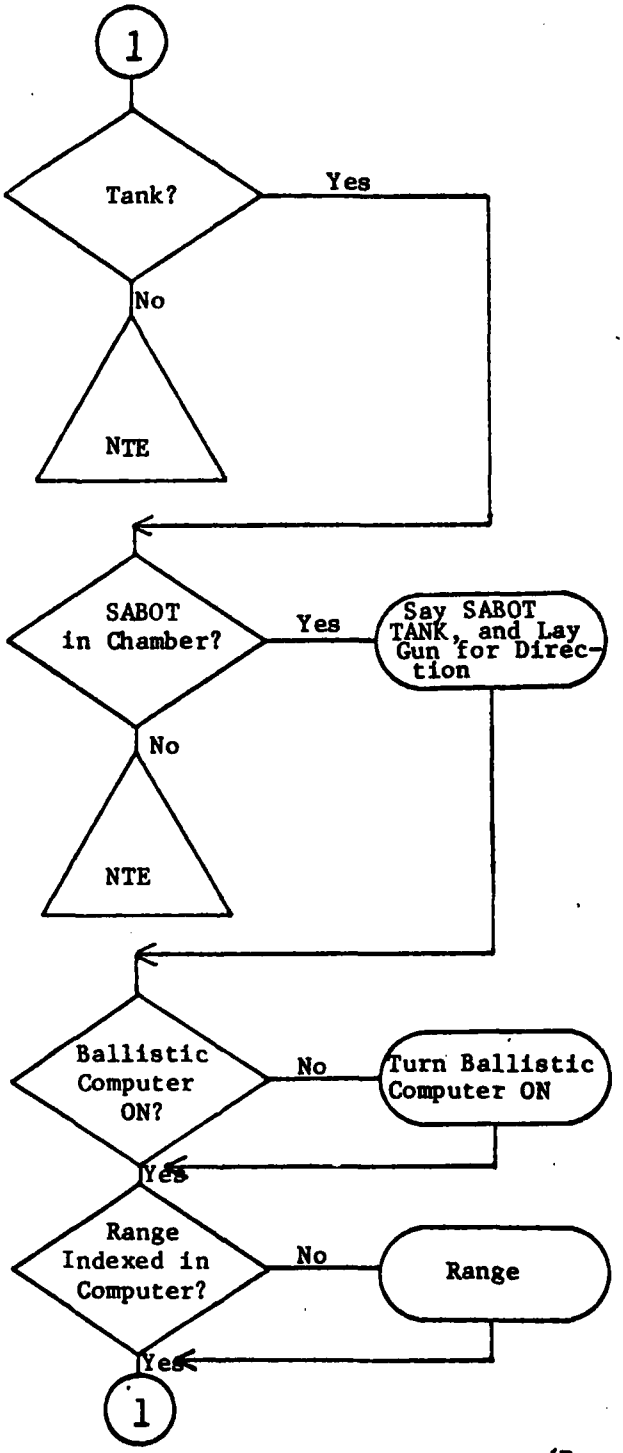

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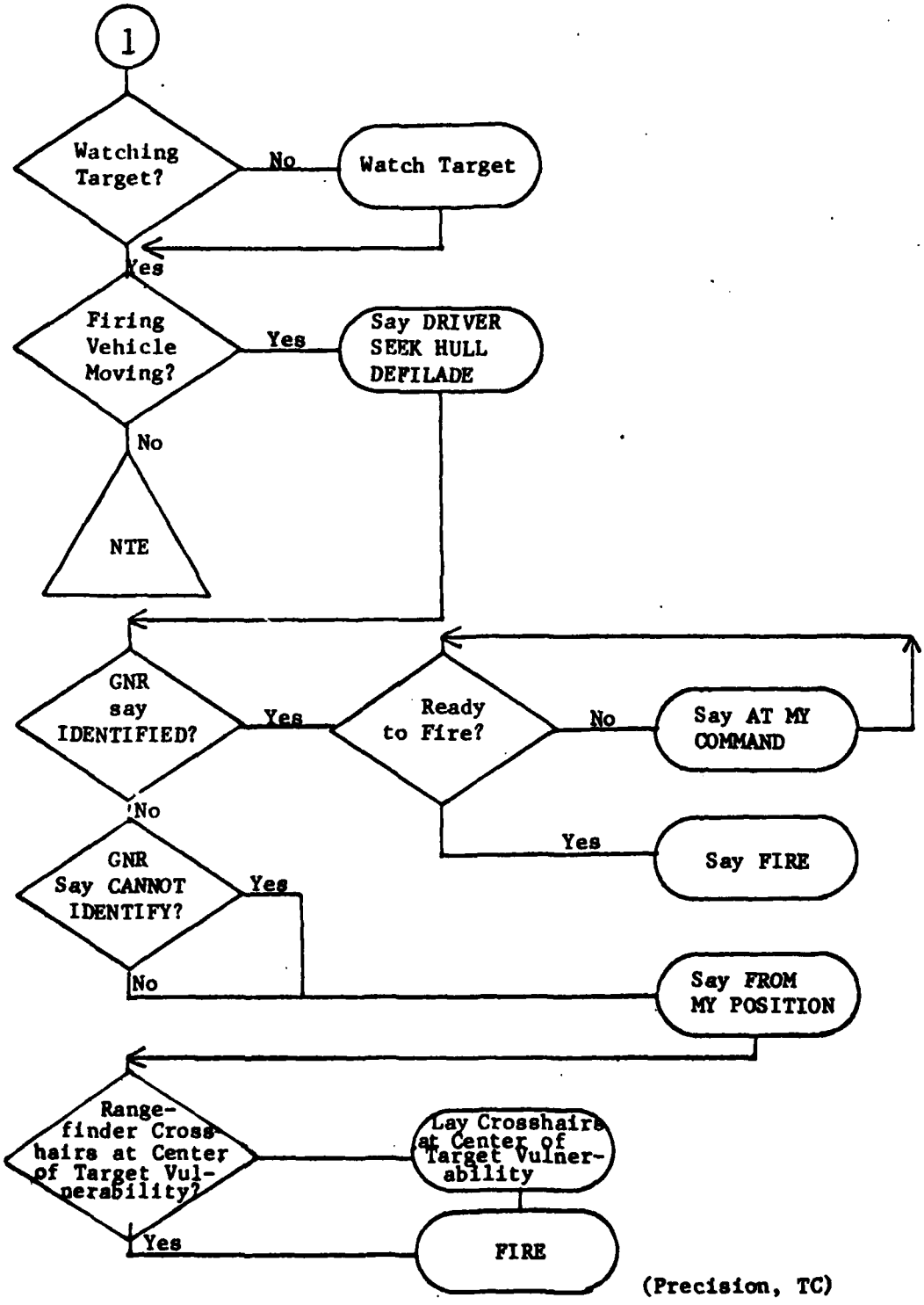

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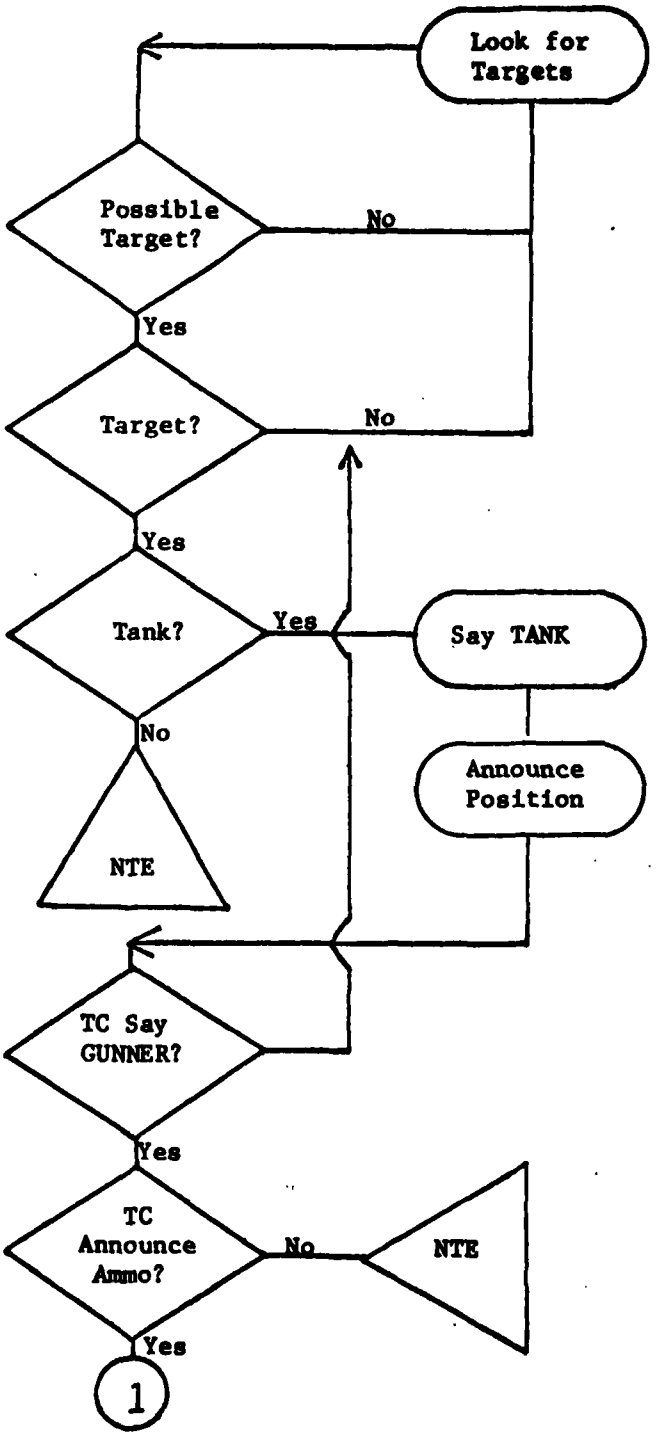

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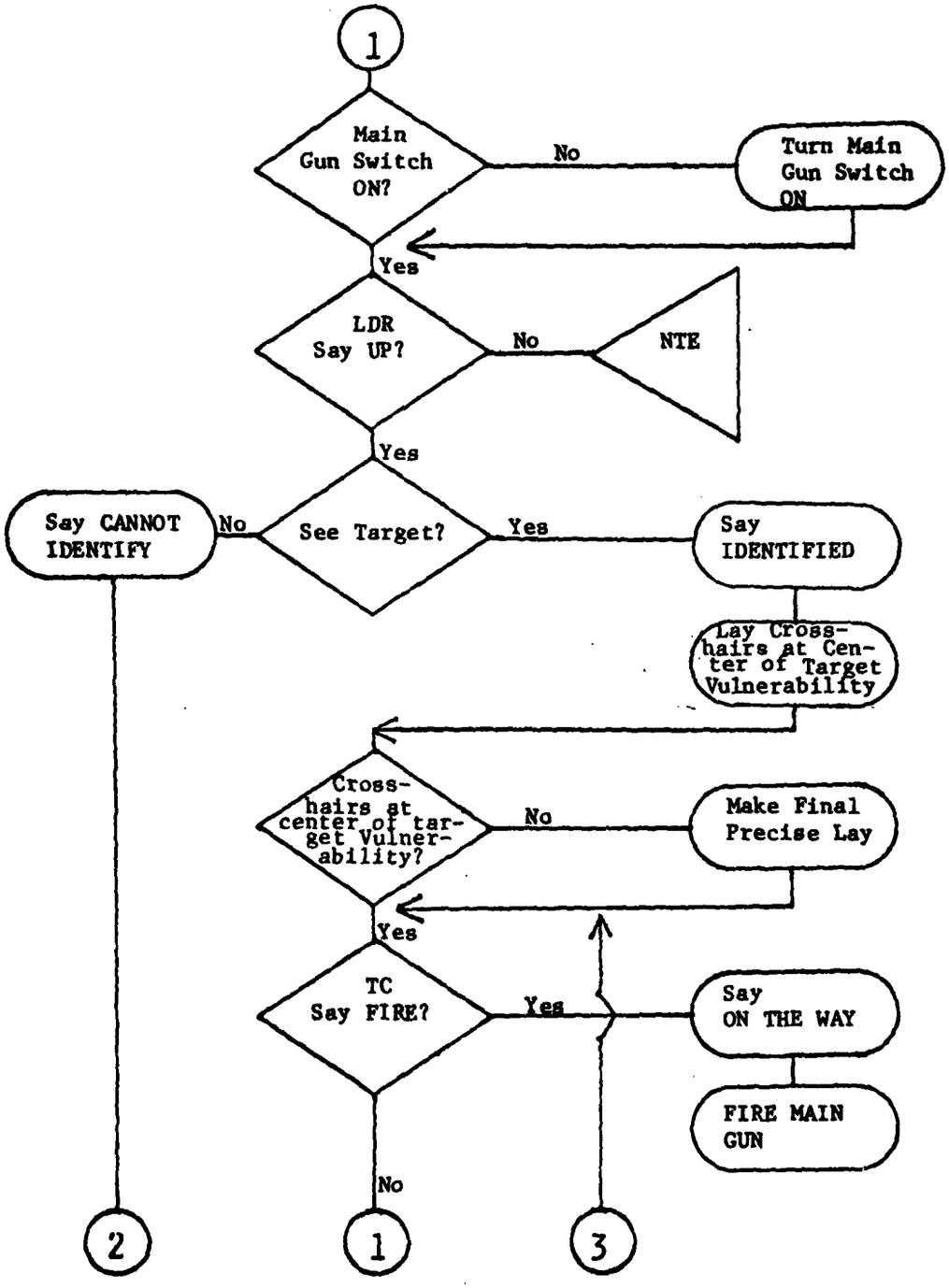

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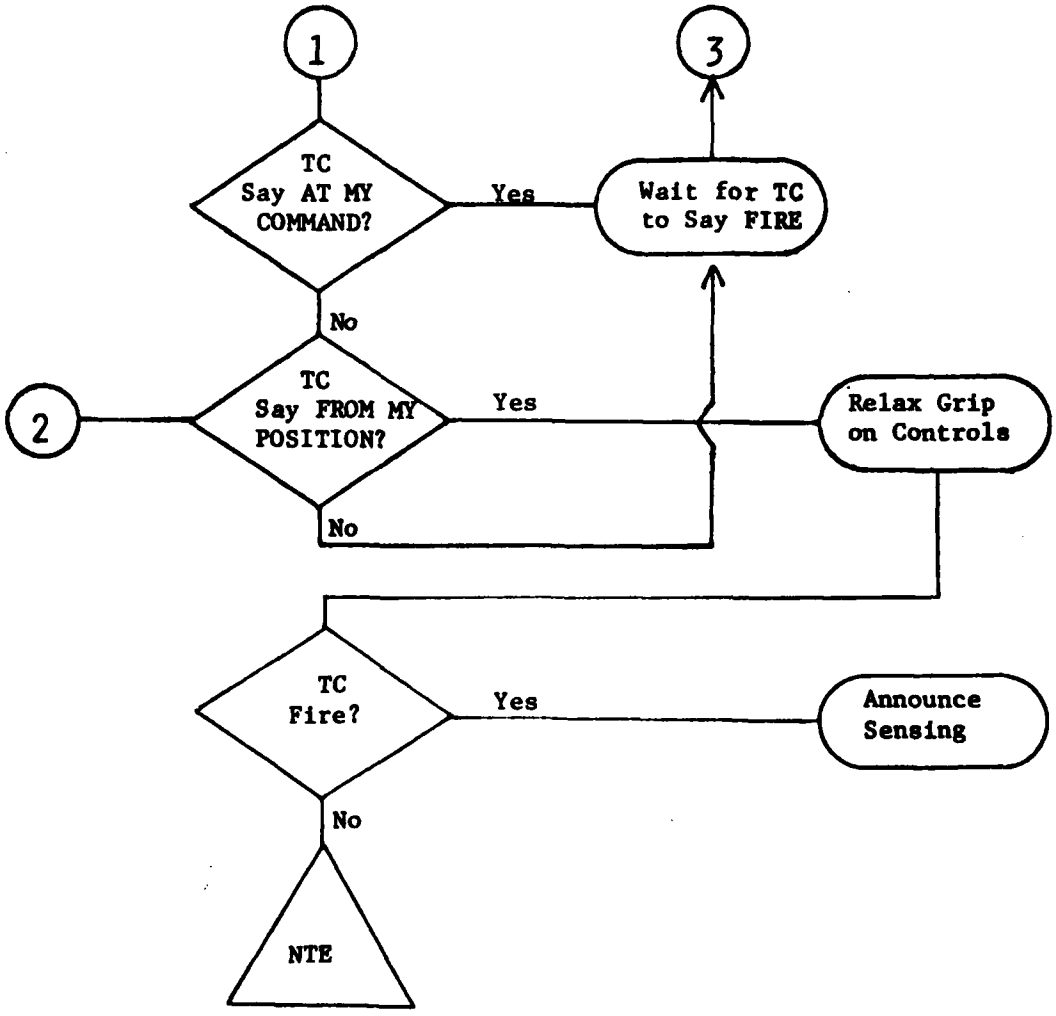

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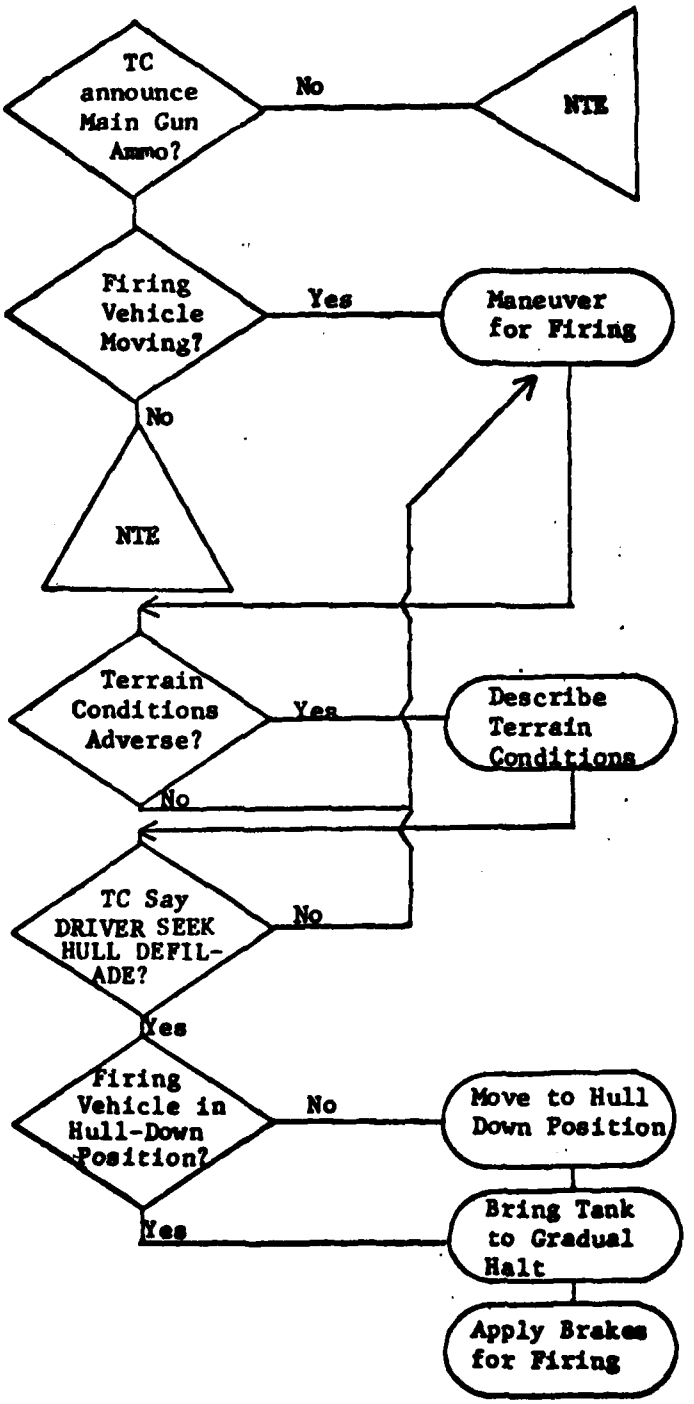
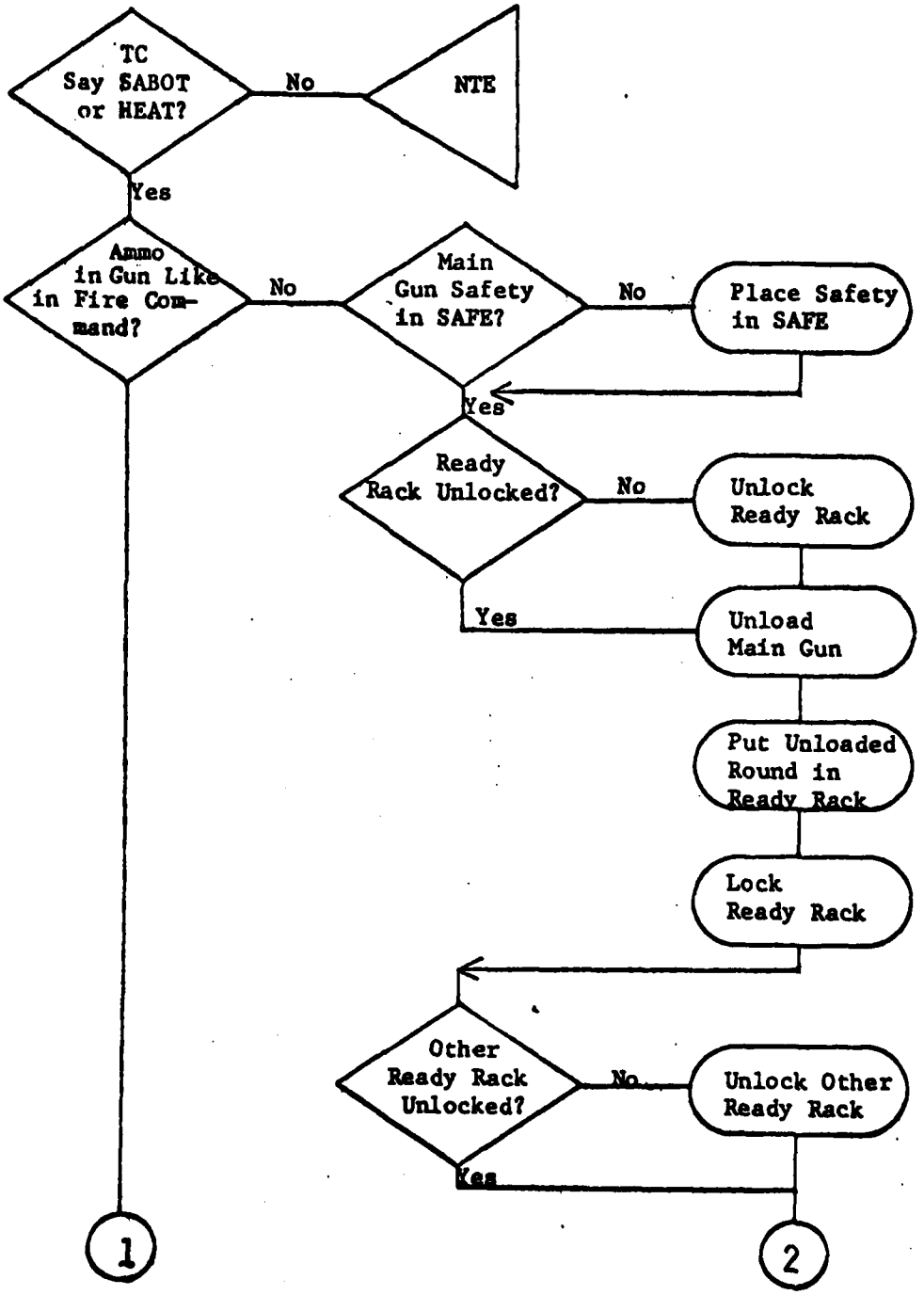


(Precision, Driver)



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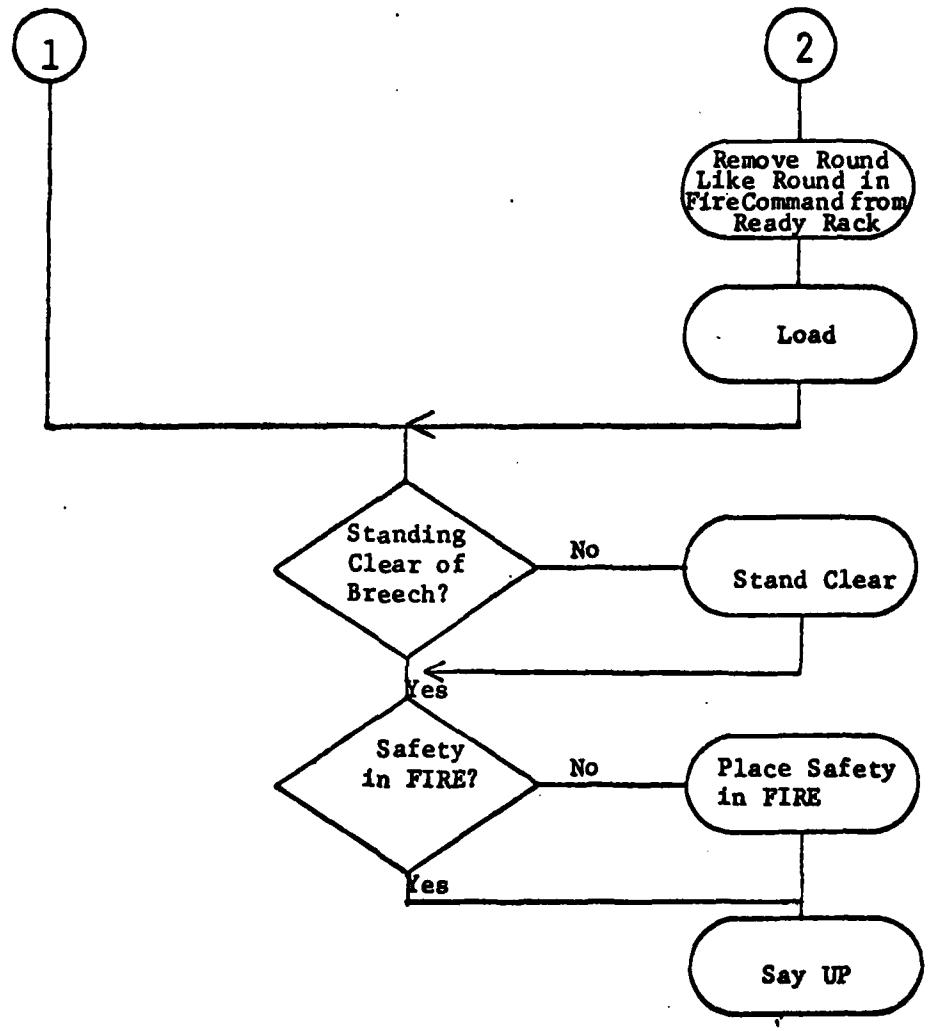
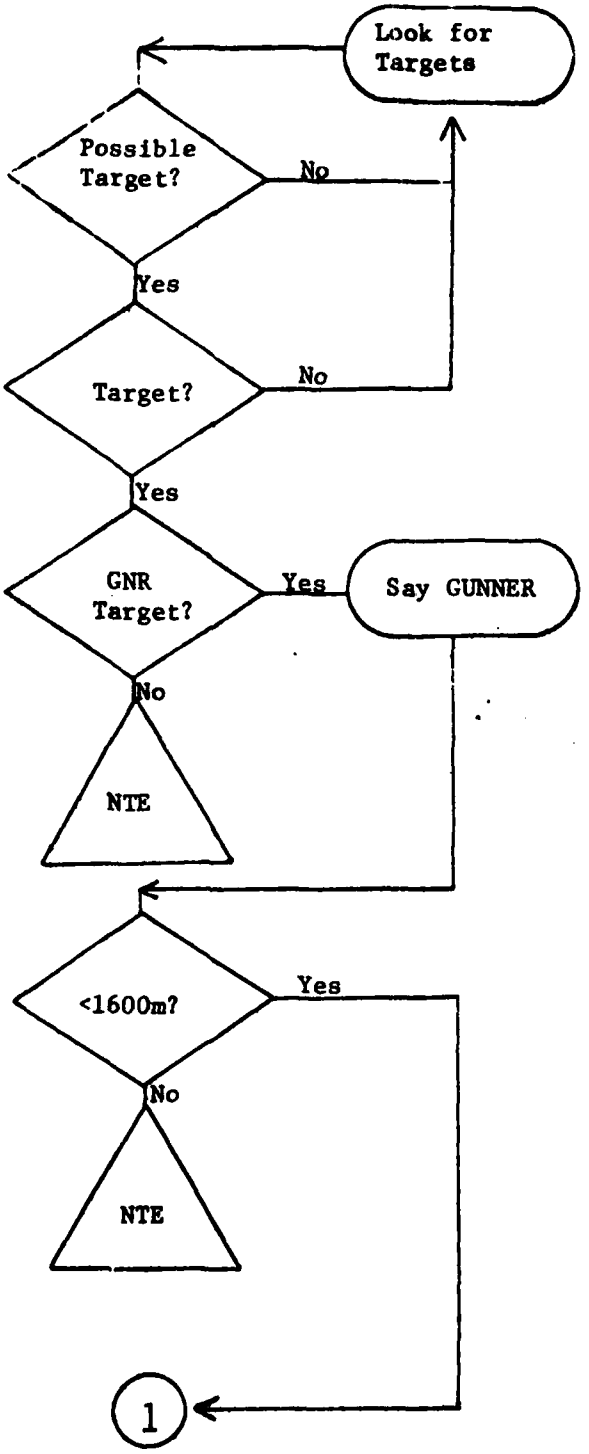


(Precision, Loader)

APPENDIX B

DECISION-RESPONSE DIAGRAMS FOR TC, GUNNER, DRIVER, AND LOADER: BATTLESIGHT ENGAGEMENT (GUNNER FIRING FROM STATIONARY TANK AT A STATIONARY TANK TARGET, VISIBLE WITHOUT ARTIFICIAL LIGHT AT LESS THAN 1600 m., USING GUNNER'S DAY PERISCOPE AND SABOT OR HEAT)



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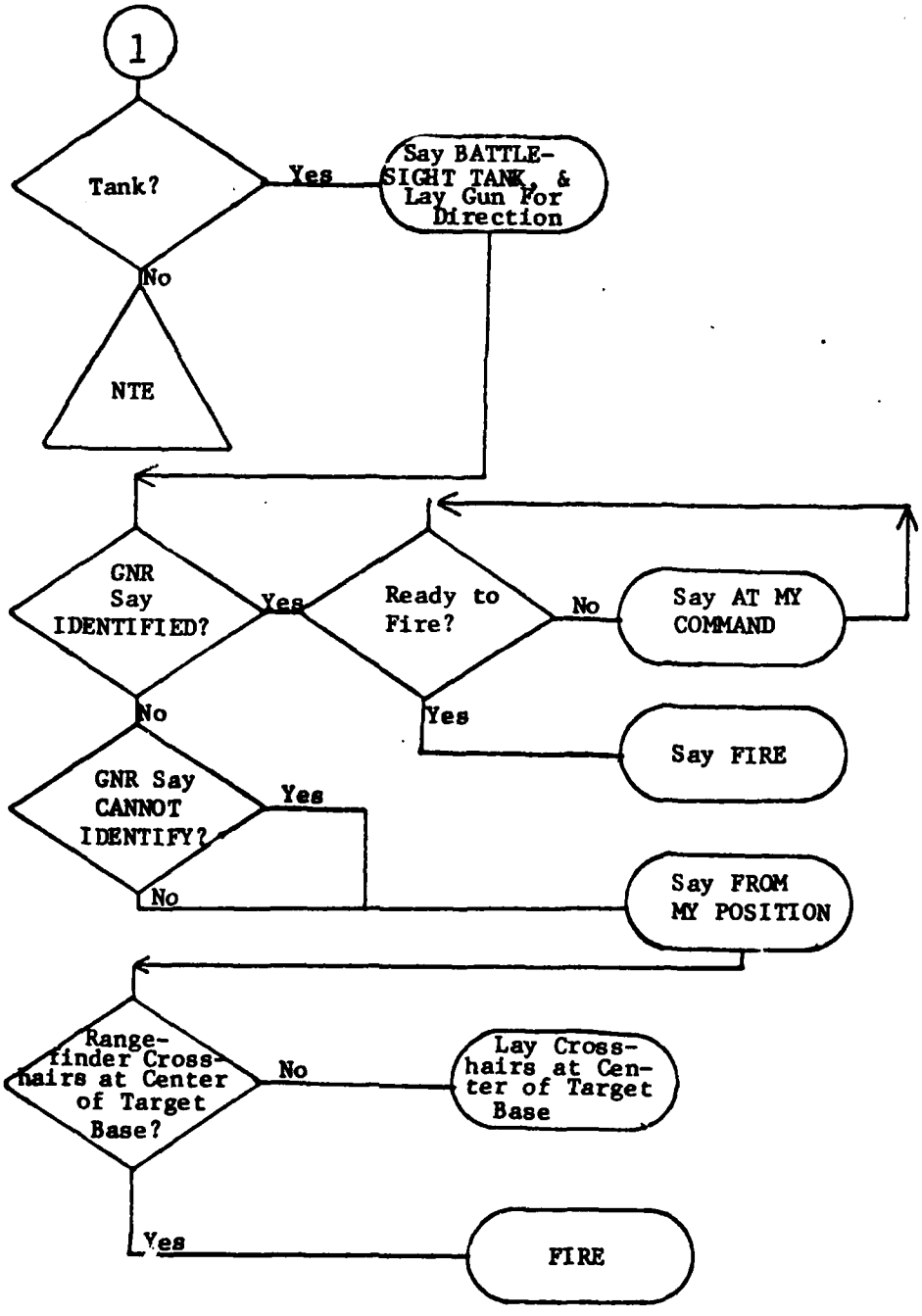

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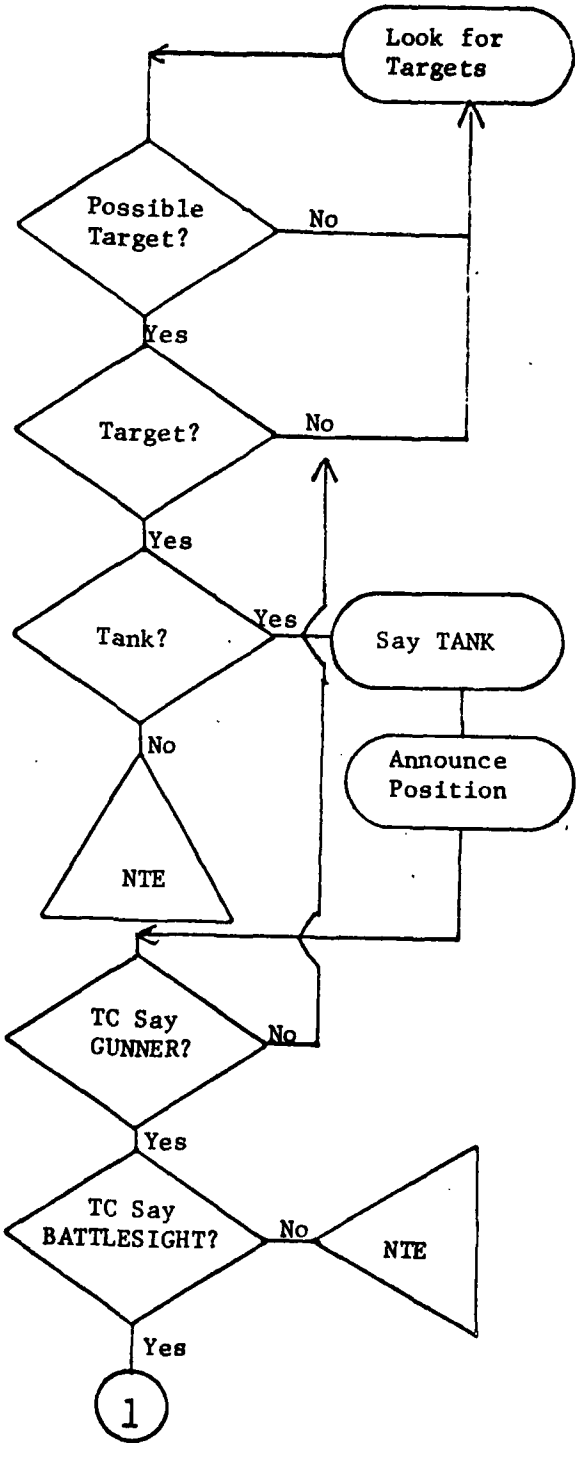

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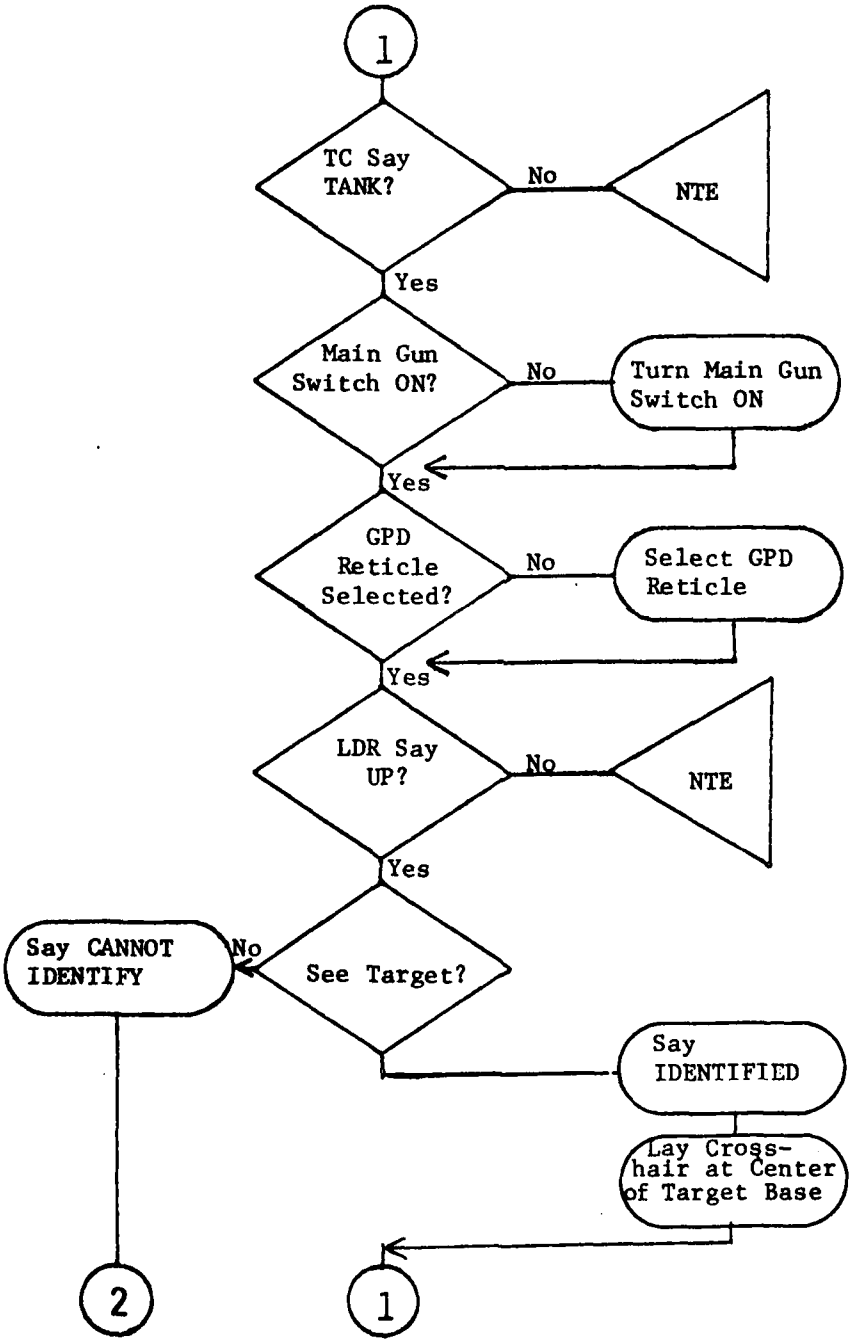

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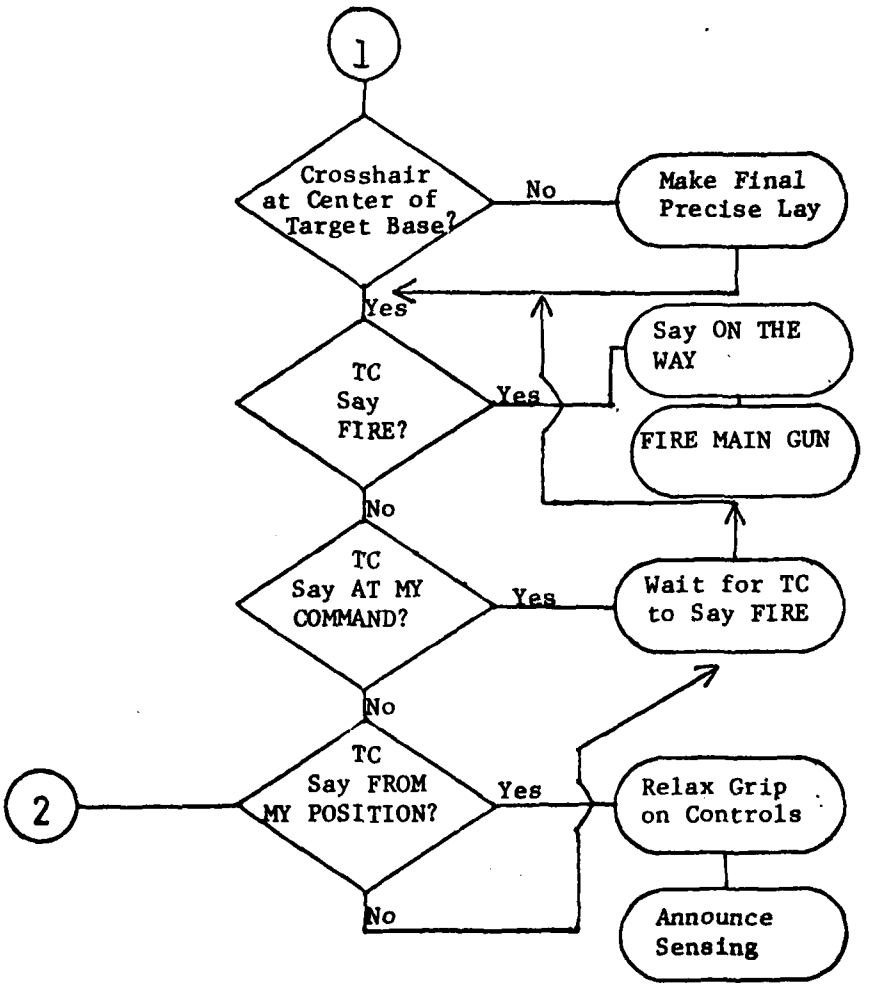

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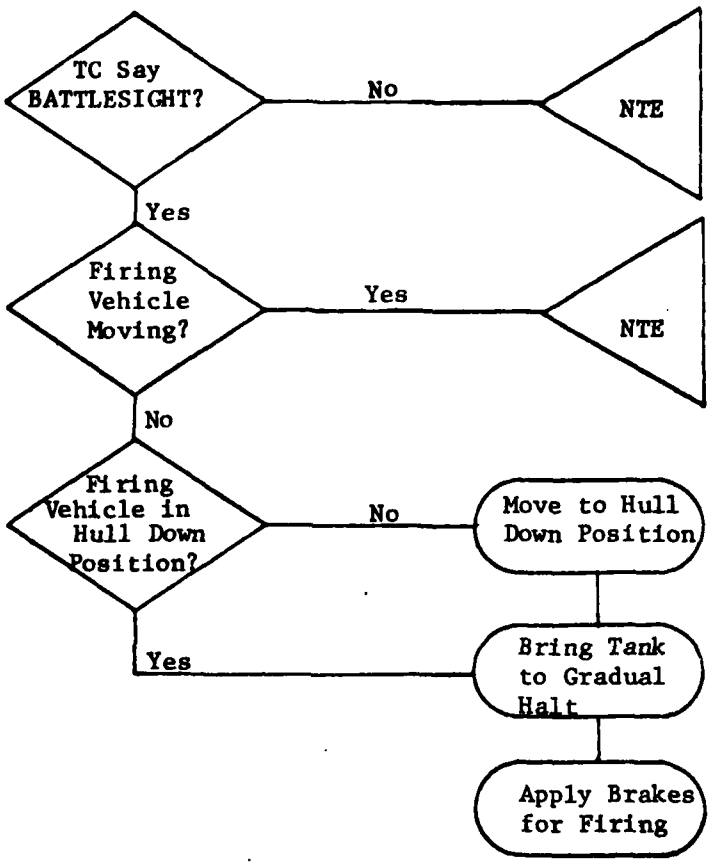
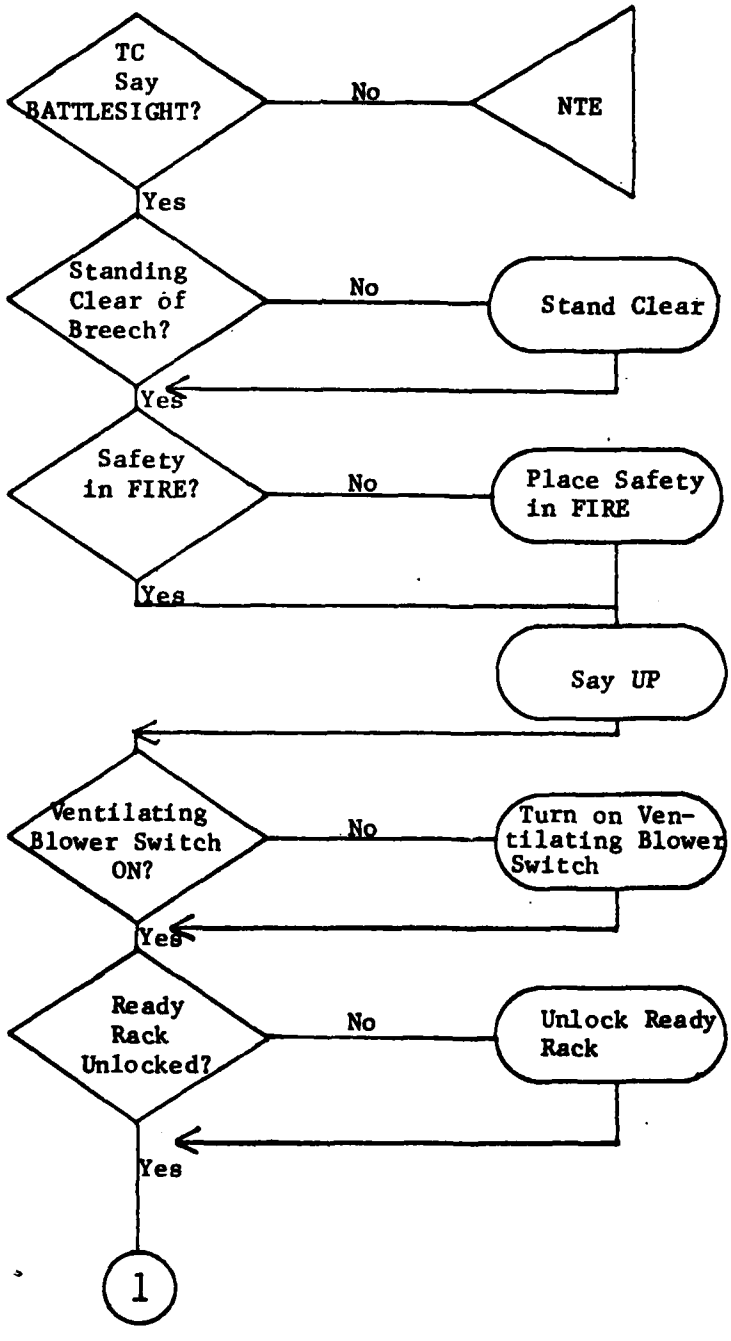
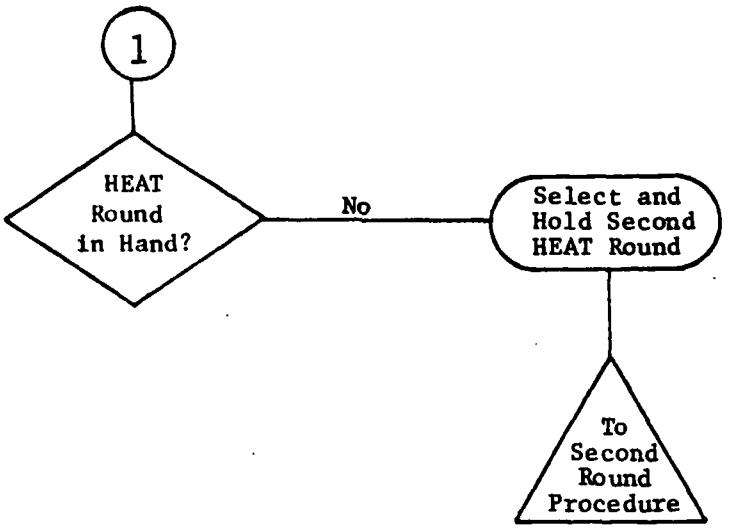


(Battlesight, Driver)



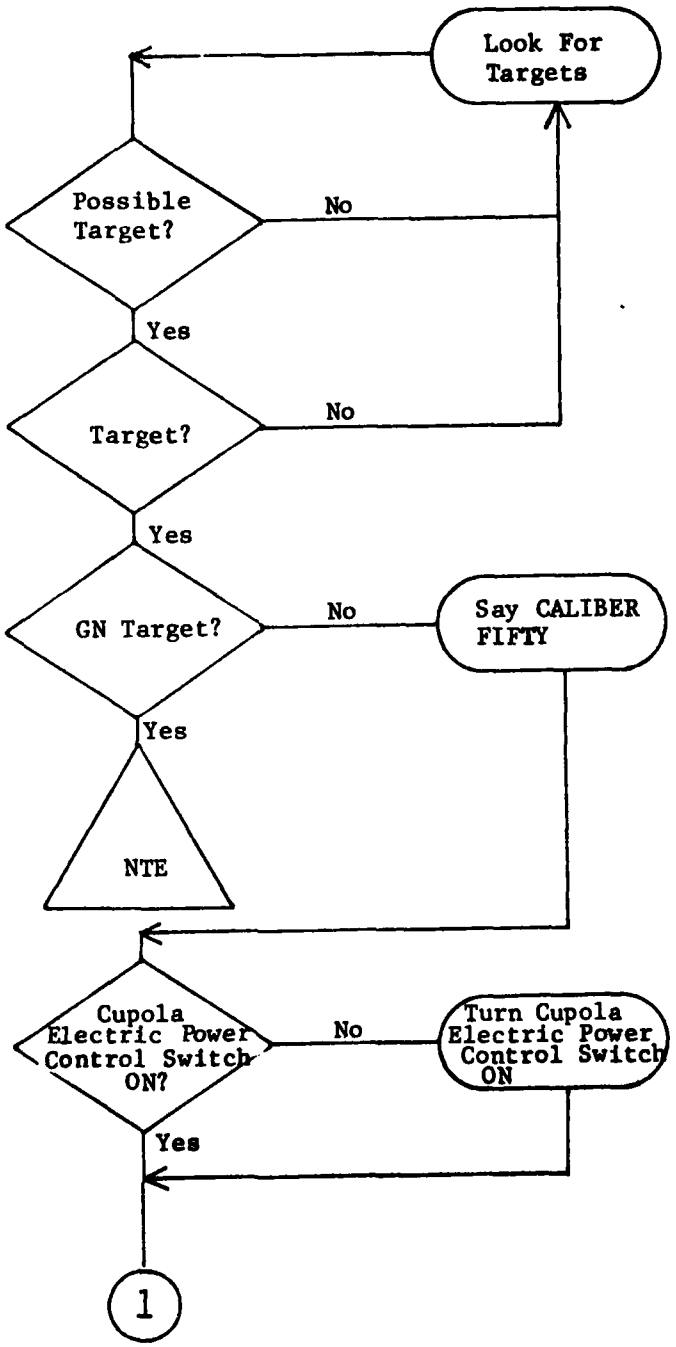
(Battlesight, Loader)



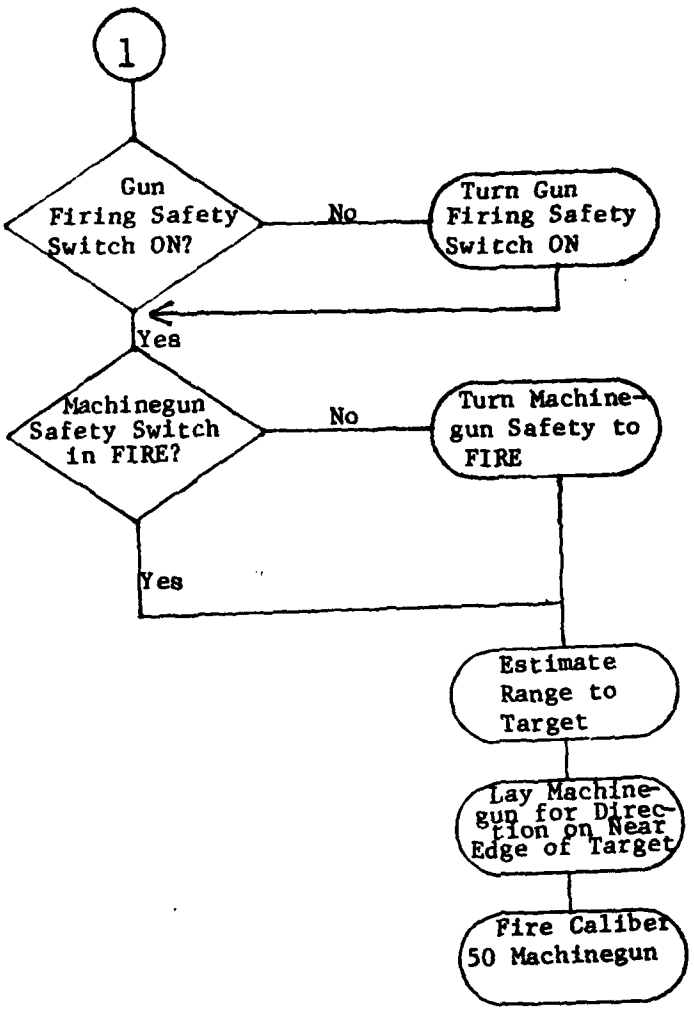
(Battlesight, Loader)

APPENDIX C

DECISION-RESPONSE DIAGRAM FOR TC: 50 CAL. ENGAGEMENT (TC FIRING FROM MOVING TANK AT TROOPS, VISIBLE WITHOUT ARTIFICIAL LIGHT AT LESS THAN 1600 m., USING TC's DAY PERISCOPE)



(.50 Caliber, TC)



(.50 Caliber, TC)

APPENDIX D

RESPONSE GROUPS, OVERT RESPONSES, AND ENABLING SKILLS FOR TC, GUNNER, DRIVER, AND LOADER: PRECISION ENGAGEMENT (GUNNER FIRING FROM TANK MOVING TO A HALT AT A STATIONARY TANK TARGET, VISIBLE WITHOUT ARTIFICIAL LIGHT AT 500 TO 4400 m., USING GUNNER'S DAY PERISCOPE AND SABOT OR HEAT)

TC: GNR MG PRE MTH/S TNK VIS 500-4400 DN GPD SBHT

1. Acquires targets

   1.1. Look for targets

      1.1.1. See entries under 2.1 and 2.2 below for enabling skills.

2. Gives fire commands in response to prospective targets and GNR's announcements

   2.1. Say GUNNER

      2.1.1. Distinguishes between prospective targets and other environmental features.

      2.1.2. Distinguishes between targets and friendlies.

      2.1.3. Distinguishes between GNR (105 and coax) and TC (105, coax, Caliber 50) targets.

   2.2. Say SABOT TANK

      2.2.1. Distinguishes between targets at <1600m and targets at >1599m.

      2.2.2. Distinguishes between tanks and other targets.

   2.3. Say DRIVER SEEK HULL DEFILADE

      2.3.1. Recalls that DRIVER SEEK HULL DEFILADE must be said if:

         . The firing vehicle is moving, and

         . The target is to be engaged in the precision mode.

   2.4. Say AT MY COMMAND

      2.4.1. Recalls that AT MY COMMAND is response to:

         . Gunner's saying IDENTIFIED, and

         . TC's not being ready to fire.

   2.5. Say FIRE

      2.5.1. Recalls that FIRE is response to:

         . GNR's saying IDENTIFIED, and

         . TC's being ready to fire.

   2.6. Say FROM MY POSITION

      2.6.1. Recalls that FROM MY POSITION is response to:

         . GNR's saying CANNOT IDENTIFY, or

         . GNR's saying nothing.

TC: GNR MG PRE MTH/S TNK VIS 500-4400 DN GPD SBHT (cont'd.)

3. Operates Main Gun

3.1. Lay gun for direction

3.1.1. Recalls that laying main gun for direction is performed simultaneously with saying GNR SABOT TANK.

3.1.2. Recalls procedure for laying main gun for direction.

3.1.3. Operates power control handle.

3.2. Fire main gun

3.2.1. Recalls that firing main gun is response to:

. Saying FROM MY POSITION, and

. Laying rangefinder crosshairs at center of target vulnerability.

3.2.2. Recalls procedure for laying rangefinder crosshairs on center of target vulnerability and firing.

3.2.3. Identifies center of target vulnerability.

4. Operates ballistic computer

4.1. Turn ballistic computer ON

4.1.1. Distinguishes among ballistic computer ON/OFF switch and other switches; and between ON and OFF positions of ballistic computer switch.

4.1.2. Recalls that turning ballistic computer ON is response to:

. Intent to index range, and

. Ballistic computer ON/OFF switch's being in OFF position.

5. Operates rangefinder

5.1. Ranges (using rangefinder)

5.1.1. Distinguishes among rangefinder crank and other controls.

5.1.2. Recalls procedure for ranging.

5.1.3. Recalls that ranging (using rangefinder) is response to:

. Intent to fire precision engagement, and

. Range's not being indexed in computer.

GNR: GNR MG PRE MTH/S TNK VIS 500-4400 DN GPD SBHT

1. Acquires targets

   1.1. Look for targets

      1.1.1. See entries under 1.2. below for enabling skills.

   1.2. Say TANK, and announce its position

      1.2.1. Distinguishes between prospective targets and other environmental features.

      1.2.2. Distinguishes between targets and friendlies.

      1.2.3. Distinguishes between tanks and other targets.

      1.2.4. Describes locations of objects in terms of position on a clock face.

      1.2.5. Recalls that target's position must be announced immediately after saying TANK.

2. Operates main gun

   2.1. Turn main gun switch ON

      2.1.1. Distinguishes among main gun and other switches, and between ON and OFF positions of main gun switch.

      2.1.2. Recalls that turning main gun switch ON is response to:

         . TC's saying GUNNER and the name of a main gun round, and

         . Main gun switch's being in OFF position.

   2.2. Lay crosshairs at center of target vulnerability

      2.2.1. Recalls that laying crosshairs at center of target vulnerability is response to:

         . TC's announcing GUNNER and main gun ammunition, and

         . GNR's saying IDENTIFIED.

      2.2.2. Recalls procedure for laying crosshairs on center of target vulnerability.

      2.2.3. Identifies center of target vulnerability.

2.3. Make final precise lay

2.3.1. Recalls that making final precise lay is response to:

. Saying IDENTIFIED, and

. Crosshairs' not being on center of target vulnerability.

2.3.2. Operates power control handle.

2.4. Fire main gun

2.4.1. Recalls that firing is response to saying ON THE WAY.

2.4.2. Recalls procedure for firing.

3. Responds to fire commands

3.1. Say IDENTIFIED

3.1.1. Recalls that saying IDENTIFIED is response to:

. TC's saying GUNNER, and

. Seeing the target, and

. LDR's saying UP.

3.2. Say CANNOT IDENTIFY

3.2.1. Recalls that saying CANNOT IDENTIFY is response to:

. TC's saying GUNNER, and

. Not seeing the target.

3.3. Say ON THE WAY

3.3.1. Recalls that saying ON THE WAY is response to:

. Crosshairs' being on center of target vulnerability, and

. TC's saying FIRE.

3.4. Wait for TC to say FIRE

3.4.1. Recalls that waiting for TC to say FIRE is response to TC's saying:

. AT MY COMMAND, or

. Nothing.

GNR: GNR MG PRE MTH/S TNK VIS 500-4400 DN GPD SBHT (cont'd.)

3.5. Relax grip on controls

3.5.1. Recalls that relaxing grip on controls is response to TC's saying FROM MY POSITION.

3.6. Announce sensing

3.6.1. Recalls that sensing round is response to TC's firing.

3.6.2. Recalls procedure for sensing round.

DVR: GNR MG PRE MTH/S TNK VIS 500-4400 GN GPD SBHT

1. Responds to fire commands

   1.1. Maneuver for firing

      1.1.1. Drives tank evasively.

      1.1.2. Recalls that maneuvering for firing is response to:

         . An ammo element in the fire command, and

         . The firing vehicle's moving.

   1.2. Move to hull-down position

      1.2.1. Locates defilade position.

      1.2.2. Drives tank evasively.

      1.2.3. Recalls that moving to hull-down position is response to:

         . TC's saying DRIVER SEEK HULL DEFILADE, and

         . Firing vehicle's not being in hull-down position.

   1.3. Bring tank to gradual halt

      1.3.1. Brakes smoothly.

      1.3.2. Recalls that braking smoothly immediately follows moving to hull-down position.

   1.4. Apply brakes for firing

      1.4.1. Recalls that applying brakes for firing immediately follows braking smoothly.

2. Responds to adverse terrain conditions

   2.1. Describe terrain conditions

      2.1.1. Locates terrain conditions that would, if traversed, affect other crew members' performance adversely.

      2.1.2. Recalls that describing terrain is immediate response to:

         . Adverse terrain conditions, and

         . Necessity to traverse them.

LDR: GNR MG PRE MTH/S TNK VIS 500-4400 DN GPD SBHT

1. Responds to fire commands

   1.1. Place safety in SAFE

      1.1.1. Recalls name of round in chamber.

      1.1.2. Notices difference between name of round in chamber and round in fire command.

      1.1.3. Recalls that placing main gun safety in SAFE is response to:

         . Difference between name of round in chamber and round in fire command, and

         . Safety's being in FIRE.

      1.1.4. Distinguishes among types of ammo by inspection.

      1.1.5. Distinguishes among main gun safety switch or lever and other switches or levers, and between SAFE and FIRE positions of main gun safety switch or lever.

   1.2. Unlock ready rack.

      1.2.1. Recalls that unlocking ready rack is response to:

         . Placing safety in SAFE, and

         . Ready rack's being locked.

      1.2.2. Locates ready rack where unloaded round will be stored.

   1.3. Unload main gun

      1.3.1. Recalls that unloading is response to:

         . Difference between ammo in fire command and ammo in chamber, and

         . Safety's being in SAFE, and

         . Ready rack's being unlocked.

      1.3.2. Recalls procedure for unloading.

   1.4. Put unloaded round in ready rack

      1.4.1. Recalls that putting round in ready rack is response to unloading.

1.5. Lock ready rack

1.5.1. Recalls that locking ready rack is response to placing round in ready rack.

1.6. Unlock other ready rack

1.6.1. Recalls that other ready rack must be unlocked before removing new round for loading.

1.6.2. Identifies round named in fire command by inspection.

1.7. Remove round like round in fire command from ready rack

1.7.1. Recalls that removing new round to be loaded is response to having:

. Placed unloaded round in ready rack, and

. Locked ready rack, and

. Unlocked other ready rack.

1.8. Load

1.8.1. Recalls that loading is response to removing round to be loaded from ready rack.

1.8.2. Recalls procedure for loading.

1.9. Stand clear

1.9.1. Recalls that standing clear is:

. Response to loading, and

. Done before placing safety in FIRE and saying UP.

2.0. Place safety in FIRE

2.0.1. Recalls that placing safety in FIRE is response to:

. Loading, and

. Standing clear.

2.1. Say UP

2.1.1. Recalls that saying UP immediately follows placing main gun safety in FIRE.

APPENDIX E

RESPONSE GROUPS, OVERT RESPONSES, AND ENABLING SKILLS FOR TC, GUNNER, DRIVER, AND LOADER: BATTLESIGHT ENGAGEMENT (GUNNER FIRING FROM STATIONARY TANK AT A STATIONARY TANK TARGET, VISIBLE WITHOUT ARTIFICIAL LIGHT AT LESS THAN 1600 m., USING GUNNER'S DAY PERISCOPE AND SABOT OR HEAT)

TC: GNR MG BS S/S TNK VIS <1600 DN GPD SBHT

1. Acquires targets

   1.1. Look for targets

      1.1.1. See entries under 2.1 and 2.2 below for enabling skills.

2. Gives fire commands in response to prospective targets and GNR's announcements

   2.1. Say GUNNER

      2.1.1. Distinguishes between prospective targets and other environmental features.

      2.1.2. Distinguishes between targets and friendlies.

      2.1.3. Distinguishes between GNR (105 and coax) and TC (105, coax, Caliber 50) targets.

   2.2. Say BATTLESIGHT TANK

      2.2.4. Distinguishes between targets at <1600m and targets >1599m.

      2.2.5. Distinguishes between tanks and other targets.

   2.3. Say AT MY COMMAND

      2.3.1. Recalls that AT MY COMMAND is response to:

         . GNR's saying IDENTIFIED, and

         . TC's not being ready to fire.

   2.4. Say FIRE

      2.4.1. Recalls that FIRE is response to:

         . GNR's saying IDENTIFIED, and

         . TC's being ready to fire.

   2.5. Say FROM MY POSITION

      2.5.1. Recalls that FROM MY POSITION is response to:

         . GNR's saying CANNOT IDENTIFY, or

         . GNR's saying nothing.

   2.6. Say ON THE WAY

      2.6.1. Recalls that ON THE WAY is response to:

         . Final precise lay's being made, and

         . Saying FROM MY POSITION.

TC: GNR MG BS S/S TNK VIS <1600 DN GPD SBHT (cont'd.)

3. Operates main gun

3.1. Lay gun for direction

3.1.1. Recalls that laying main gun for direction immediately follows saying BATTLESIGHT.

3.1.2. Recalls procedure for laying main gun for direction.

3.1.3. Operates power control handle.

3.2. Fire main gun

3.2.1. Recalls that firing main gun is response to:

- Saying FROM MY POSITION, and
- Laying rangefinder crosshairs on center of target base.

3.2.2. Recalls procedure for laying rangefinder crosshairs on center of target base and firing.

3.2.3. Identifies center of target base.

GNR: GNR MG BS S/S TNK VIS <1600 DN GPD SBHT

1. Acquires targets

   1.1. Look for targets

      1.1.1. See entries under 1.2. below for enabling skills.

   1.2. Say TANK, and announce its position

      1.2.1. Distinguishes between prospective targets and other environmental features.

      1.2.2. Distinguishes between targets and friendlies.

      1.2.3. Distinguishes between tanks and other targets.

      1.2.4. Describes locations of objects in terms of position on a clock face.

      1.2.5. Recalls that target's position must be announced immediately after saying TANK.

2. Operates main gun

   2.1. Turn main gun switch ON

      2.1.1. Distinguishes among main gun and other switches, and between ON and OFF positions, of main gun switch.

      2.1.2. Recalls that turning main gun switch ON is response to:

         . TC's saying GUNNER BATTLESIGHT TANK, and

         . Main gun switch's being in the OFF position.

   2.2. Select GPD reticle

      2.2.1. Distinguishes between GNR's periscope and GNR's secondary sight.

      2.2.2. Recalls that selecting GPD sight is response to:

         . TC's saying GUNNER BATTLESIGHT TANK.

   2.3. Lay crosshair at center of target base

      2.3.1. Recalls that laying crosshair on center of target base is response to:

         . TC's saying GUNNER BATTLESIGHT TANK, and

         . GNR's saying IDENTIFIED.

GNR: GNR MG BS S/S TNK VIS <1600 DN GPD SBHT (cont'd.)

3.5. Relax grip on controls

3.5.1. Recalls that relaxing grip on controls is response to TC's saying FROM MY POSITION.

3.6. Announce sensing

3.6.1. Recalls that sensing round is response to TC's firing.

3.6.2. Recalls procedure for sensing round.

GNR: GNR MG BS S/S TNK VIS <1600 DN GPD SBHT (cont'd.)

2.3.2. Recalls procedure for laying crosshairs on center of target base.

2.3.3. Identifies center of target base.

2.4. Make final precise lay

2.4.1. Recalls that making final precise lay is response to:

. Saying IDENTIFIED, and

. Crosshairs' not being on center of target base.

2.4.2. Operates power control handle.

2.5. Fire main gun

2.5.1. Recalls that firing is response to saying ON THE WAY.

2.5.2. Recalls procedure for firing.

3. Responds to fire commands

3.1. Say IDENTIFIED

3.1.1. Recalls that saying IDENTIFIED is response to:

. TC's saying GUNNER, and

. GNR's seeing the target.

3.2. Say CANNOT IDENTIFY

3.2.1. Recalls that saying CANNOT IDENTIFY is response to:

. TC's saying GUNNER, and

. Not seeing the target.

3.3. Say ON THE WAY

3.3.1. Recalls that saying ON THE WAY is response to:

. Crosshair's being on center of target base, and

. TC's saying FIRE.

3.4. Wait for TC to say FIRE

3.4.1. Recalls that waiting for TC to say FIRE is response to TC's saying:

. AT MY COMMAND, or

. Nothing.

DVR: GNR MG BS S/S TNK VIS <1600 DN GPD SBHT

1. Responds to fire commands

    1.1. Move to hull-down position

        1.1.1. Recalls that moving to a hull-down position is response to:

            . TC's saying GUNNER BATTLESIGHT, and

            . The firing vehicle's not being in a defilade position.

        1.1.2. Locates defilade position.

        1.1.3. Drives tank evasively.

    1.2. Bring tank to a gradual halt

        1.2.1. Brakes smoothly.

        1.2.2. Recalls that braking smoothly immediately follows moving to hull-down position.

    1.3. Apply brakes for firing

        1.3.1. Recalls that applying brakes for firing immediately follows braking smoothly.

LDR: GNR MG BS S/S TNK VIS <1600 DN GPD SBHT

1. Responds to fire commands

   1.1. Stand clear

      1.1.1. Recalls that standing clear is:

         . Response to TC's saying BATTLESIGHT, and

         . Done before placing safety in FIRE and saying UP.

   1.2. Place safety in FIRE

      1.2.1. Recalls that placing safety in FIRE is immediate response to:

         . TC's saying BATTLESIGHT, and

         . Standing clear.

   1.3. Say UP

      1.3.1. Recalls that saying UP immediately follows placing main gun safety in FIRE.

2. Prepares for second round firing

   2.1. Unlock ready rack

      2.1.1. Recalls that ready rack must be unlocked before removing round for loading.

   2.2. Select and hold second round for loading

      2.2.1. Identifies round named in fire command by inspection.

TC: TC 50 M/TRP VIS <1600 TCPD

1. Acquires targets

   1.1. Look for targets

      1.1.1. See entries under 2.1 below for enabling skills.

2. Gives fire command in response to prospective targets

   2.1. Say CALIBER FIFTY

      2.1.1. Distinguishes between prospective targets and other environmental features.

      2.1.2. Distinguishes between targets and friendlies.

      2.1.3. Distinguishes among Cal 50 and other targets.

3. Prepares to operate Cal 50 machinegun

   3.1. Turn cupola electric power control switch ON

      3.1.1. Recalls that turning cupola electric power control switch ON is response to:

         . Saying CALIBER FIFTY.

         . Cupola electric power control switch's being OFF.

      3.1.2. Distinguishes among cupola electric power control switch and other switches, and between ON and OFF positions of cupola power switch.

   3.2. Turn gun firing safety switch ON

      3.2.1. Recalls that turning gun firing safety switch ON is response to:

         . Turning cupola electric power control switch ON.

         . Gun firing safety switch's being OFF.

      3.2.2. Distinguishes among gun and other safety switches, and between ON and OFF positions of gun safety switch.

APPENDIX F

RESPONSE GROUPS, OVERT RESPONSES, AND ENABLING SKILLS FOR TC: 50 CAL. ENGAGEMENT (TC FIRING FROM MOVING TANK AT TROOPS, VISIBLE WITHOUT ARTIFICIAL LIGHT AT LESS THAN 1600 m., USING TC's DAY PERISCOPE)

4.2.4. Operates manual elevation handle.

4.2.5. Recalls that machinegun ballistic reticle is laid on near edge of target when using the "Z" pattern.

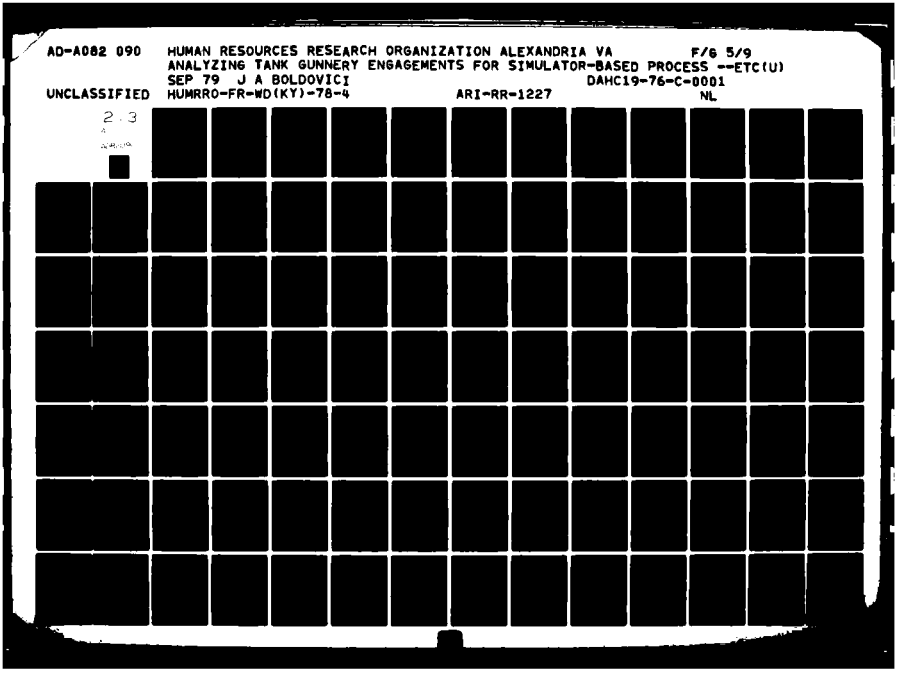
4.3. Fire

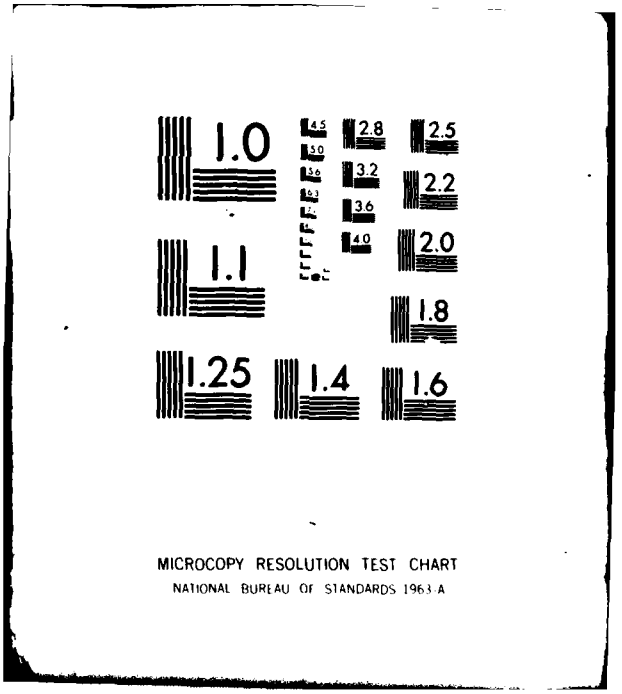
4.3.1. Recalls that firing caliber 50 machinegun is response to:

. Saying CALIBER FIFTY.

. Laying machinegun for direction.

AD-A082 090 HUMAN RESOURCES RESEARCH ORGANIZATION ALEXANDRIA VA F/6 5/9
ANALYZING TANK GUNNERY ENGAGEMENTS FOR SIMULATOR-BASED PROCESS --ETC(U)
SEP 79 J A BOLDOVICI DAHC19-76-C-0001
UNCLASSIFIED HUMRRO-FR-WD(KY)-78-4 ARI-RR-1227 NL

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6.3
7.1
MICROCOPY RESOLUTION TEST CHART
NATIONAL BUREAU OF STANDARDS 1963-A

TC: TC 50 M/TRP VIS <1600 TCPD (cont'd.)

3.3. Turn machinegun safety switch to FIRE

3.3.1. Recalls that turning machinegun safety switch to FIRE is response to:

. Turning gun safety switch ON.

. Machinegun safety switch's being in SAFE.

3.3.2. Distinguishes among machinegun safety switch and other switches, and between SAFE and FIRE positions of safety switch.

4. Operates caliber 50 machinegun

4.1. Estimate range to target

4.1.1. Recalls that estimating range to target immediately follows turning machinegun safety switch to FIRE.

4.1.2. Recalls recognition method of range determination.

4.1.3. Recalls that the following targets are recognizable with the naked eye to the ranges indicated below:

Tank crew members, Troops, Machinegun/Mortar, Antitank gun/Antitank missile launcher	500 meters
Tank, Armored Personnel Carrier, Truck, by model	1000 meters
Tank, Howitzer, APC, Truck, by model	1500 meters
Armored Vehicle, Wheeled Vehicle	2000 meters

4.2. Lay machinegun for direction

4.2.1. Recalls that troops are area targets.

4.2.2. Recalls that the "Z" pattern provides coverage for area targets.

4.2.3. Operates TC power control handle.

APPENDIX G

MEASUREMENT SPECIFICATIONS FOR TC, GUNNER, DRIVER, AND LOADER: PRECISION ENGAGEMENT (GUNNER FIRING FROM TANK MOVING TO A HALT AT A STATIONARY TANK TARGET, VISIBLE WITHOUT ARTIFICIAL LIGHT AT 500-4400 m., USING GUNNER'S DAY PERISCOPE AND SABOT OR HEAT)

Numbering Note:

Three digits = enabling skill
Two digits = overt response
One digit = response group

TANK COMMANDER MEASUREMENT

GNR MG PRE MTH/S TNK VIS 500-4400 DN GPD SBHT

PRE TC: 1. ACQUIRES TARGETS

. TARGET ACQUISITION IS MEASURED AS PART OF THE OVERT RESPONSES AND ENABLING SKILLS IN RESPONSE GROUP PRE TC 2., "GIVES FIRE COMMANDS IN RESPONSE TO PROSPECTIVE TARGETS AND GUNNER'S ANNOUNCEMENTS."

PRE TC: 2. GIVES FIRE COMMANDS IN RESPONSE TO PROSPECTIVE TARGETS AND GNR'S ANNOUNCEMENTS

SAMPLE TEST SCENARIO

- TC in firing vehicle simulator is instructed that various prospective targets will appear in his area of surveillance, and that he is to give fire commands in response to the prospective targets and to the GNR's announcements.

- The test consists of 16 items, which differ from one another in terms of prospective target (that is, targets or friendlies), firing vehicle motion (moving or stationary), GNR's announcement (IDENTIFIED, CANNOT IDENTIFY, or none), and target aspect (obscured or visible) after GNR's announcement. The 16 items, summarized in the table below, are to be presented in random order.

ITEM NO.	TARGET (various ranges >1600m)	FIRING VEHICLE MOTION	GNR'S RESPONSE TO GUNNER SABOT TANK	TARGET ASPECT AFTER GNR SAYS IDENTIFIED	FIRE COMMAND
1	Warsaw Pact Tank	Moving	IDENTIFIED	Obscured	GUNNER SABOT TANK/DRIVER STOP/ AT MY COMMAND
2	Warsaw Pact Tank	Moving	IDENTIFIED	Visible	GUNNER SABOT TANK/DRIVER STOP/ FIRE
3	Warsaw Pact Tank	Moving	CANNOT IDENTIFY	Visible	GUNNER SABOT TANK/DRIVER STOP/ FROM MY POSITION
4	Warsaw Pact Tank	Moving	None	Visible	GUNNER SABOT TANK/DRIVER STOP/ FROM MY POSITION
5	Warsaw Pact Tank	Stationary	IDENTIFIED	Obscured	GUNNER SABOT TANK/AT MY COMMAND
6	Warsaw Pact Tank	Stationary	IDENTIFIED	Visible	GUNNER SABOT TANK/FIRE
7	Warsaw Pact Tank	Stationary	CANNOT IDENTIFY	Visible	GUNNER SABOT TANK/FROM MY POSITION
8	Warsaw Pact Tank	Stationary	None	Visible	GUNNER SABOT TANK/FROM MY POSITION
9-16	Friendly	Stationary or Moving	N/A	N/A	None

MEASUREMENT

- Mean time (in sec) between appearance of target and end of TC's fire command.
- Accuracy, as indicated by giving the fire command or saying nothing in response to each item shown in the table above.
- Maximum possible correct = 16 = 8 fire commands + 8 silences.

PRE TC: 2.1. SAY GUNNER

SAMPLE TEST SCENARIO

- TC overlooking simulation of rolling, partly wooded terrain is instructed to monitor his area of surveillance, and to say GUNNER in response to GNR targets, and nothing in response to TC targets, friendlies, and "non-targets."

- Three moving GNR targets, 2 moving TC targets, 3 moving friendlies, and 2 moving NPT (no possible target; e.g., civilian vehicles) appear on terrain which contains 2 stationary GNR targets, 3 stationary TC targets, 2 stationary friendlies, and 3 stationary NPT, singly and in likely combinations, in random order, at the ranges given in the table below, within a total of 2 min, at various positions within the TC's area of surveillance, at various angles of regard.

	TARGETS		F	NPT
	GNR	TC		
M	<400m 800-1199 1600-1999	400-799m 1200-1599	<400m 800-1199 1600-1999	400-799m 1200-1599
S	400-799 1200-1599	<400 800-1199 1600-1999	400-799 1200-1599	<400 800-1199 1600-1999

F = friendly, M = moving, S = stationary.
Ranges in meters.

MEASUREMENT

- Mean time (in sec) between <u>appearance of GNR targets</u> and <u>TC's saying GUNNER</u>.

- Accuracy, as indicated by the response GUNNER to GNR targets, and by saying nothing in response to TC targets, friendlies, and "non-targets."

- Max = 20 = 5 announcements of GUNNER + 15 silences.

PRE TC: 2.1.1. DISTINGUISHES BETWEEN PROSPECTIVE TARGETS AND OTHER ENVIRONMENTAL FEATURES

SAMPLE TEST SCENARIO

- TC overlooking simulation of rolling, partly wooded terrain is instructed to monitor his area of surveillance and to say POSSIBLE in response to targets and friendlies, and nothing in response to NPT.

- Three moving targets, 2 moving friendlies, and 5 moving NPT ("no possible target"; e.g., civilian vehicles) appear on terrain which contains 2 stationary targets, 3 stationary friendlies and 5 stationary NPT (e.g., barns, houses), singly and in likely combinations, in random order, at the ranges given in the table below, within a total of 2 min, at various positions within the TC's area of surveillance, at various angles of regard.

	T	F	NPT
M	<400m 800-1199 1600-1999	400-799m 1200-1599	<400m 400-799 800-1199 1200-1599 1600-1999
S	400-799 1200-1599	<400 300-1199 1600-1999	<400 400-799 800-1199 1200-1599 1600-1999

T = target, F = friendly, NPT = no possible target,
M = moving, S = stationary.
Ranges in meters.

MEASUREMENT

- Mean time (in sec) between appearance of prospective targets and TC's saying POSSIBLE.

- Accuracy, as indicated by the response POSSIBLE to prospective targets, and by saying nothing in response to NPT.

- Max = 20 = 10 announcements of POSSIBLE + 10 silences.

PRE TC: 2.1.2. DISTINGUISHES BETWEEN TARGETS AND FRIENDLIES

SAMPLE TEST SCENARIO

- TC overlooking simulation of rolling, partly wooded terrain is instructed to monitor his area of surveillance, and to say TARGET in response to targets, and nothing in response to friendlies.

- Five moving targets and 5 moving friendlies appear on terrain which contains 5 stationary targets and 5 stationary friendlies, singly and in likely combinations, in random order, at the ranges given in the table below, within a total of 2 min, at various positions within the TC's area of surveillance, at various angles of regard.

	T	F
M	<400m 400-799 800-1199 1200-1599 1600-1999	<400m 400-799 800-1199 1200-1599 1600-1999
S	<400 400-799 800-1199 1200-1599 1600-1999	<400 400-799 800-1199 1200-1599 1600-1999

T = target, F = friendly, M = moving, S = stationary. Ranges in meters.

MEASUREMENT

- Mean time (in sec) between appearance of targets and TC's saying TARGET.

- Accuracy, as indicated by the response TARGET to targets, and by saying nothing in response to friendlies.

- Max = 20 = 10 announcements of TARGET + 10 silences.

PRE TC: 2.1.3. DISTINGUISHES BETWEEN GNR (105 AND COAX) AND TC (105, COAX, AND CAL 50) TARGETS

SAMPLE TEST SCENARIO

- TC overlooking simulation of rolling, partly wooded terrain is instructed to monitor his area of surveillance, and to say GUNNER in response to GNR targets, and nothing in response to TC targets.

- Three moving 105mm targets, 5 moving 50 cal targets, and 2 moving 7.62mm targets appear on terrain which contains 2 stationary 105mm targets, 5 stationary 50 cal targets, and 3 stationary 7.62mm targets, singly and in likely combinations, in random order, at the ranges given in the table below, within a total of 2 min, at various positions within the TC's area of surveillance, at various angles of regard.

	TARGETS		
	105mm	.50 cal	7.62mm
M	<400m 800-1199 1600-1999	<400m 400-799 800-1199 1200-1599 1600-1999	100-299m 500-699
S	400-799 1200-1599	<400 400-799 800-1199 1200-1599 1600-1999	>100m 300-499 700-899

M = moving, S = stationary.
Ranges in meters.

MEASUREMENT

- Mean time (in sec) between <u>appearance of GNR targets</u> and <u>TC's saying GUNNER</u>.

- Accuracy, as indicated by the response GUNNER to GNR targets, and by saying nothing in response to TC targets.

- Max = 20 = 10 announcements of GUNNER and 10 silences.

PRE TC: 2.2. SAY SABOT TANK

SAMPLE TEST SCENARIO

- TC overlooking simulation of rolling, partly wooded terrain is instructed to monitor his area of surveillance and to say SABOT TANK in response to Warsaw Pact tanks at >1599m, and nothing in response to other targets.

- Five moving Warsaw Pact tanks and 5 other moving targets appear on terrain which contains 5 stationary Warsaw Pact tanks and 5 other stationary targets, at the ranges given in the table below, within a total of 2 min, at various positions within the TC's area of surveillance, at various angles of regard.

	TARGETS	
	TANKS	OTHER
M	1 at 1450-1524m 1 at 1675-1749 3 at 1525-1674	1 at 1450-1524m 1 at 1675-1749 3 at 1525-1674
S	1 at 1450-1524 1 at 1675-1749 3 at 1525-1674	1 at 1450-1524 1 at 1675-1749 3 at 1525-1674

M = moving, S = stationary.
Ranges in meters.

MEASUREMENT

- Mean time (in sec) between appearance of tank targets at >1599m and TC's saying SABOT TANK.

- Accuracy, as indicated by the response SABOT TANK to tank targets at >1599m, and by saying nothing in response to other targets.

- Max = 20 = any combination of 4 to 10 announcements of SABOT TANK + 4 to 10 silences equalling 20. Exact numbers depend on actual ranges of the 12 targets at 1525 to 1674m.

PRE TC: 2.2.1. DISTINGUISHES BETWEEN TARGETS AT <1600m AND TARGETS AT >1599m

SAMPLE TEST SCENARIO

- TC overlooking simulation of rolling, partly wooded terrain is instructed to monitor his area of surveillance, and to say LESS in response to targets at <1600m, and MORE in response to targets at >1599m.

- Five moving targets appear on terrain which contains 5 stationary targets, singly and in likely combinations, in random order, at the ranges given in the table below, within a total of 1 min, at various positions within the TC's area of surveillance, at various angles of regard.

	TARGETS
M	1 at 1450-1524m 1 at 1675-1749 3 at 1525-1674
S	1 at 1450-1524 1 at 1675-1749 3 at 1525-1674

M = moving, S = stationary.
Ranges in meters.

MEASUREMENT

- Mean time (in sec) between appearance of targets and TC's saying MORE or LESS.

- Accuracy, as indicated by the responses LESS to targets at <1600m, and MORE to targets at >1599m.

- Max = 10 = any combination of 2 to 8 announcements of MORE + 2 to 8 announcements of LESS equalling 10. Exact numbers depend on actual ranges of the 6 targets at 1525 to 1674m.

PRE TC: 2.2.2. DISTINGUISHES BETWEEN TANKS AND OTHER TARGETS

SAMPLE TEST SCENARIO

. TC overlooking simulation of rolling, partly wooded terrain is instructed to monitor his area of surveillance, and to say YES in response to tank targets, and NO in response to other targets.

. Three moving Warsaw Pact tanks and 2 other moving targets appear on terrain which contains 2 stationary Warsaw Pact tanks and 3 other stationary targets, singly and in likely combinations, in random order, at the ranges given in the table below, within a total of 1 min, at various positions within the TC's area of surveillance, at various angles of regard.

	TARGETS	
	TANKS	OTHER
M	<400m 800-1199 1600-1999	400-799m 1200-1599
S	400-799 1200-1599	<400 800-1199 1600-1999

M = moving, S = stationary.
Ranges in meters.

MEASUREMENT

. Mean time (in sec) between appearance of targets and TC's saying YES or NO.

. Accuracy, as indicated by the responses YES to tank targets, and NO to other targets.

. Max = 10 = 5 YES + 5 NO.

PRE TC: 2.3. SAY DRIVER STOP

SAMPLE TEST SCENARIO

- TC in firing vehicle simulator overlooking rolling, partly wooded terrain, is instructed to monitor his area of surveillance and to give a fire command to DVR or say nothing, depending on firing vehicle motion and target engagement mode.

- The test consists of 10 trials, 5 in a stationary firing vehicle and 5 in a moving vehicle, with tank targets at the following ranges: 2 at 1450-1524m, 2 at 1675-1749m, and 6 at 1525-1674m.

MEASUREMENT

- Mean time (in sec) between appearance of tank targets at >1599 meters and TC's saying DRIVER STOP from a moving firing vehicle.

- Accuracy, as indicated by the response DRIVER STOP to tank targets at >1599m when the firing vehicle is moving, and by saying nothing in response to tank targets at other ranges (regardless of firing vehicle motion).

- Max = 10. Exact combinations of numbers of DRIVER STOP announcements and silences depend on firing vehicle motion and actual ranges of the 6 targets at 1525-1674m.

PRE TC: 2.3.1. RECALLS THAT DRIVER STOP MUST BE SAID IF THE FIRING VEHICLE IS MOVING AND THE TARGET IS TO BE ENGAGED IN THE PRECISION MODE

SAMPLE TEST SCENARIO

- TC is asked, "What directions must be given to the DVR when your firing vehicle is moving and you are going to fire in the precision mode?

MEASUREMENT

- Time (in sec) between end of question and end of answer.
- Accuracy, as indicated by answering DRIVER SEEK HULL DEFILADE to the item given above.
- Max = 1.

PRE TC: 2.4. SAY AT MY COMMAND

SAMPLE TEST SCENARIO

- TC is instructed that GNR is laying crosshairs on center of target vulnerability, and that TC is to react to GNR's forthcoming announcement by giving a fire command which will delay firing. GNR then says IDENTIFIED.

MEASUREMENT

- Time (in sec) between end of GNR's saying IDENTIFIED and end of TC's saying AT MY COMMAND.
- Accuracy, as indicated by saying AT MY COMMAND in response to GNR's saying IDENTIFIED.
- Max = 1.

PRE TC: 2.4.1. RECALLS THAT SAYING AT MY COMMAND IS RESPONSE TO GUNNER'S SAYING IDENTIFIED AND TC'S NOT BEING READY TO FIRE

SAMPLE TEST SCENARIO

- TC is asked, "What fire command must be given when the GNR says IDENTIFIED and you want to delay firing on the target?"

MEASUREMENT

- Time (in sec) between end of question and end of answer.
- Accuracy, as indicated by answering AT MY COMMAND to the item given above.
- Max = 1.

PRE TC: 2.5. SAY FIRE

SAMPLE TEST SCENARIO

- TC is instructed that GNR is laying crosshairs on center of target vulnerability, and that TC is to react to GNR's forthcoming announcement by giving a command which will result in the GNR's firing. GNR then says IDENTIFIED.

MEASUREMENT

- Time (in sec) between end of GNR's saying IDENTIFIED and end of TC's saying FIRE.
- Accuracy, as indicated by saying FIRE in response to GNR's saying IDENTIFIED.
- Max = 1.

PRE TC: 2.5.1. RECALLS THAT FIRE IS RESPONSE TO GUNNER'S SAYING IDENTIFIED AND TC'S BEING READY TO FIRE

SAMPLE TEST SCENARIO

. TC is asked, "What fire command must be given when the GNR says IDENTIFIED and you are ready to fire on the target?"

MEASUREMENT

. Time (in sec) between end of question and end of answer.

. Accuracy, as indicated by answering FIRE to the item given above.

. Max = 1.

PRE TC: 2.6. SAY FROM MY POSITION

SAMPLE TEST SCENARIO

- TC is instructed that GNR is laying crosshairs on center of target vulnerability, and that TC is to react to GNR's forthcoming announcement by giving a command which will result in completion of the engagement. GNR then says CANNOT IDENTIFY.[1]

MEASUREMENT

- Time (in sec) between end of GNR's saying CANNOT IDENTIFY and end of TC's saying FROM MY POSITION.
- Accuracy, as indicated by saying FROM MY POSITION in response to GNR's saying CANNOT IDENTIFY.
- Max = 1.

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[1]This specification is for measuring the TC's mastery of saying FROM MY POSITION in response to the GNR's saying CANNOT IDENTIFY. Another instance in which the correct TC response is to say FROM MY POSITION occurs when the GNR says nothing in response to the TC's initial fire command. This contingency was not addressed in the specification above, because at the level the specification is written, the measure of response latency would be the time between the GNR's saying nothing, and the TC's saying FROM MY POSITION. Obtaining this measure would be difficult, even with computers. More importantly, saying FROM MY POSITION in response to the GNR's saying nothing is in essence an emergency procedure, which would occur as the result of an equipment failure, for example, or the GNR's death. Performance of emergency procedures is best tested in context, because testing it out of context usually requires instructions that reduce test validity. Telling the TC, "This is a test of what you would do if your gunner were greased," for example, might elicit performance different from that which would be elicited were the GNR to "die" as part of a routine gunnery test. The TC's mastery of saying FROM MY POSITION in response to the GNR's saying nothing is tested in context as part of the specification for PRE TC 3., OPERATES MAIN GUN. The TC's knowledge about the contingency is addressed in the specification for PRE TC 2.6.1., RECALLS THAT FROM MY POSITION IS RESPONSE TO GUNNER'S SAYING CANNOT IDENTIFY OR GUNNER'S SAYING NOTHING.

PRE TC: 2.6.1. RECALLS THAT FROM MY POSITION IS RESPONSE TO GUNNER'S SAYING CANNOT IDENTIFY OR GUNNER'S SAYING NOTHING

SAMPLE TEST SCENARIO

. TC is asked two questions:

1. "You have announced GUNNER SABOT TANK. The GNR does not respond. What fire command must you give?"
2. "You have announced GUNNER SABOT TANK. The GNR says CANNOT IDENTIFY. What fire command must you give?"

MEASUREMENT

. Mean time (in sec) between end of each question and end of each answer.

. Accuracy, as indicated by answering FROM MY POSITION in response to both of the items given above.

. Max = 2.

PRE TC: 3. OPERATES MAIN GUN

SAMPLE TEST SCENARIO

- **TC in firing vehicle simulator is instructed that various prospective targets will appear in his area of surveillance, and that he is to give fire commands and operate the main gun in response to targets and to GNR's announcements; and that he is to say and do nothing in response to friendlies.**
- **Ballistic computer is ON, with 600m indexed.**
- **Gun tube is 30° off target at the start of each trial.**
- **Five Warsaw Pact tanks, and five NATO tanks appear singly and in random order, within a total of three minutes, at various ranges >1600m.**
- **If TC gives a fire command in response to seeing a NATO tank, he is notified of his error, and the test continues, using another of the remaining prospective targets.**
- **If TC says GUNNER SABOT TANK in response to a Warsaw Pact tank, the GNR is to say CANNOT IDENTIFY in all cases but one, in which GNR is to say nothing.**

MEASUREMENT

- Mean time (in sec) between <u>appearance of targets (Warsaw Pact tanks)</u> and <u>closing of firing trigger switch</u>.
- Accuracy, as indicated by:
  1. Remaining silent and not firing in response to appearance of NATO tanks. (Both components--remaining silent and not firing--constitute one correct response.)
  2. Saying GUNNER SABOT TANK in response to the 5 Warsaw Pact tanks, saying FROM MY POSITION in response to GNR's saying CANNOT IDENTIFY or nothing, and firing on targets (All three components--GUNNER SABOT TANK/FROM MY POSITION/ firing--constitute one correct response.)
  3. Distance between intersection of rangefinder crosshairs and center of target of vulnerability.
- Max = 10 correct responses, weighted for accuracy of lay.

PRE TC: 3.1. LAY GUN FOR DIRECTION

SAMPLE TEST SCENARIO

- TC in firing vehicle simulator is instructed that various prospective targets will appear in his area of surveillance, and that he is to say GUNNER SABOT TANK in response to targets, and to do that part of his job which always accompanies saying GUNNER SABOT TANK; and that he is to say and do nothing in response to friendlies.
- Gun tube is 30° off target at the start of each trial.
- Ballistic computer is ON, with 600m indexed.
- Five Warsaw Pact tanks appear singly within a total of 1.5 min at various ranges >1600m.

MEASUREMENT

- Mean time (in sec) between end of saying GUNNER SABOT TANK and a) beginning of gun movement, and b) end of gun movement.
- Accuracy as indicated by:
    1. Saying GUNNER SABOT TANK and traversing main gun. (Both components constitute one correct response.)
    2. Distance between intersection of rangefinder crosshairs and center of target vulnerability.
- Max = 5 correct responses, weighted for accuracy of lay.

PRE TC: 3.1.1. RECALLS THAT LAYING MAIN GUN FOR DIRECTION IS PERFORMED SIMULTANEOUSLY WITH SAYING GUNNER SABOT TANK

SAMPLE TEST SCENARIO

. TC is asked "You are announcing GUNNER SABOT TANK. What should you be doing at the same time?"

MEASUREMENT

. Time (in sec) between end of question and end of answer.

. Accuracy, as indicated by answering LAYING GUN FOR DIRECTION in response to the item given above.

. Max = 1.

PRE TC: 3.1.2. RECALLS PROCEDURE FOR LAYING GUN FOR DIRECTION

SAMPLE TEST SCENARIO

- TC is asked to state the steps in laying the main gun for direction.

MEASUREMENT

- Mean time (in sec) between end of question and end of answer.
- Accuracy, as indicated by match between steps given by TC and those shown on answer key.
- Max = Depends on key.

PRE TC: 3.1.3. OPERATES POWER CONTROL HANDLE

SAMPLE TEST SCENARIO

. TC in turret or simulation of turret, with operational power control handle is instructed to TRAVERSE LEFT, TRAVERSE RIGHT, DEPRESS, ELEVATE.

MEASUREMENT

. Mean time (in sec) between end of each command and initiation of movement in direction indicated by command.

. Accuracy, as indicated by difference in number of degrees between line traversed by gun and horizontal or vertical.

. Max = 4.

PRE TC: 3.2. FIRE MAIN GUN

SAMPLE TEST SCENARIO

- TC in firing vehicle simulator is instructed to say FROM MY POSITION, and to do that part of his job which immediately follows saying FROM MY POSITION.
- Gun tube is 30° off target.
- Ballistic computer is ON, with 600m indexed.
- One Warsaw Pact tank appears at >1600m.

MEASUREMENT

- Time (in sec) between end of saying FROM MY POSITION and a) beginning of traverse, b) end of traverse, and c) closing of firing trigger switch.
- Accuracy, as indicated by:
    1. Saying FROM MY POSITION, laying crosshairs, and firing. (All three components constitute one correct response.)
    2. Distance between intersection of rangefinder crosshairs and center of target vulnerability.
- Max = one correct response, weighted for accuracy of lay.

PRE TC: 3.2.1. RECALLS THAT FIRING MAIN GUN IS RESPONSE TO SAYING FROM MY POSITION AND LAYING RANGEFINDER CROSSHAIRS AT CENTER OF TARGET VULNERABILITY

SAMPLE TEST SCENARIO

- TC is told, "You have just announced FROM MY POSITION, and have laid the rangefinder crosshairs on the center of target vulnerability"; and asked, "What do you do next?"

MEASUREMENT

- Time (in sec) between end of question and end of answer.
- Accuracy, as indicated by answering FIRE in response to the item given above.
- Max = 1.

PRE TC: 3.2.2. RECALLS PROCEDURE FOR LAYING RANGEFINDER CROSS-HAIRS ON CENTER OF TARGET VULNERABILITY AND FIRING

SAMPLE TEST SCENARIO

. TC is asked to state the steps in laying crosshairs on center of target vulnerability and firing.

MEASUREMENT

. Mean time (in sec) between end of instructions and end of answer.

. Accuracy, as indicated by match between steps given by TC and those shown on answer key.

. Max = Depends on key.

PRE TC: 3.2.3. IDENTIFIES CENTER OF TARGET VULNERABILITY

SAMPLE TEST SCENARIO

. TC is instructed to point to or mark the center of vulnerability on 20 representations of Warsaw Pact tanks, shown at various angles of regard, and at apparent ranges of 50 to 2500 m.

MEASUREMENT

. Mean time (in sec) between end of instructions and end of response.

. Accuracy, as indicated by distance between actual and indicated centers of vulnerability.

. Max = 20.

PRE TC: 4. OPERATES BALLISTIC COMPUTER

SAMPLE TEST SCENARIO

- TC in firing vehicle simulator is instructed that a target will appear in his area of surveillance, and that he is to give a fire command and to range in response to the appearance of the target.
- Ballistic computer is OFF.
- Gun tube is 30° off target.
- Warsaw Pact tank appears at >1600m.

MEASUREMENT

- Time (in sec) between end of fire command and closing computer ON/OFF switch.
- Accuracy, as indicated by ON/OFF switch's being in ON position.
- Max = 1.

PRE TC: 4.1. TURN BALLISTIC COMPUTER ON

SAMPLE TEST SCENARIO

- TC in firing vehicle simulator is instructed that a target will appear in his area of surveillance, and that he is to say GUNNER SABOT TANK, and to do that part of his job which immediately follows saying GUNNER SABOT TANK.
- Ballistic computer is OFF.
- Gun tube is 30° off target.
- Warsaw Pact tank appears at >1600m.

MEASUREMENT

- Time (in sec) between end of saying GUNNER SABOT TANK and closing computer ON/OFF switch.
- Accuracy, as indicated by ON/OFF switch's being in ON position.
- Max = 1.

PRE TC: 4.1.1. DISTINGUISHES AMONG BALLISTIC COMPUTER ON/OFF SWITCH AND OTHER SWITCHES, AND BETWEEN ON AND OFF POSITIONS OF BALLISTIC COMPUTER SWITCH

SAMPLE TEST SCENARIO

- TC is instructed to point to or mark ballistic computer switch ON and OFF positions on representation of TC's rangefinder.

MEASUREMENT

- Mean time (in sec) between end of instructions and end of each response.
- Accuracy, as indicated by identifying switch, and identifying ON and OFF positions.
- Max = 2 = 1 for locating switch + 1 for identifying ON and OFF positions. No part credit is given for identifying ON position only or OFF position only; that is, examinee gets 1 or nothing for identifying ON and OFF positions. Thus the only possible numbers of correct responses are 0, 1, and 2:
  - 0 = switch not located
  - 1 = switch located, with ON/OFF identification reversed, missing, or identical.
  - 2 = switch located, with ON/OFF identification correct.

PRE TC: 4.1.2. *RECALLS THAT TURNING BALLISTIC COMPUTER ON IS* RESPONSE TO INTENT TO INDEX RANGE, AND BALLISTIC COMPUTER ON/OFF SWITCH'S BEING IN OFF POSITION

SAMPLE TEST SCENARIO

- TC is told, "You intend to index range into the ballistic computer, and the computer is OFF"; and asked, "What do you do?"

MEASUREMENT

- Time (in sec) between end of question and end of answer.
- Accuracy, as indicated by answering TURN COMPUTER ON in response to the item given above.
- Max = 1.

PRE TC: 5. OPERATES RANGEFINDER

SAMPLE TEST SCENARIO

- TC in firing vehicle simulator is instructed that a target will appear in his area of surveillance, and that he is to give a fire command and perform all other duties which will result in the GNR's neutralizing the target.
- Ballistic computer is ON, with 600m indexed.
- Gun tube is 30° off target.
- Warsaw Pact tank appears at >1600m.

MEASUREMENT

- Time (in sec) between end of gun travel and appearance of last numbers in range scale.
- Accuracy, as indicated by difference (in meters) between actual range and range shown in range scale.
- Max = one correct response, weighted for accuracy of lay.

PRE TC: 5.1. RANGES (USING RANGEFINDER)

SAMPLE TEST SCENARIO

- TC in firing vehicle simulator is instructed that a target will appear in his area of surveillance, and that he is to say GUNNER SABOT TANK, and to do that part of his job which immediately follows saying GUNNER SABOT TANK.
- Ballistic computer is ON, with 600m indexed.
- Gun tube is 30° off target.
- Warsaw Pact tank appears at >1600m.

MEASUREMENT

- Time (in sec) between end of gun travel and appearance of last numbers in range scale.
- Accuracy, as indicated by difference (in meters) between actual range and range shown in range scale.
- Max = one correct response, weighted for accuracy of ranging.

PRE TC: 5.1.1. DISTINGUISHES AMONG RANGEFINDER CRANK AND OTHER CONTROLS

SAMPLE TEST SCENARIO

- TC is asked to point to or mark rangefinder crank on representation of rangefinder.

MEASUREMENT

- Time (in sec) between end of instructions and end of response.
- Accuracy, as indicated by identifying crank.
- Max = 1.

PRE TC: 5.1.2. RECALLS PROCEDURE FOR RANGING

SAMPLE TEST SCENARIO

. TC is asked to state the steps in ranging (with range-finder,)

MEASUREMENT

. Mean time (in sec) between end of instructions and end of answer.

. Accuracy, as indicated by match between steps given by TC and those shown on answer key.

. Max = Depends on key.

PRE TC: 5.1.3. RECALLS THAT RANGING (USING RANGEFINDER) IS RESPONSE TO INTENT TO FIRE PRECISION ENGAGEMENT AND RANGE'S NOT BEING INDEXED IN COMPUTER

SAMPLE TEST SCENARIO

- TC is told, "You intend to fire a precision engagement, and range has not yet been indexed into the ballistic computer"; and asked,"What must you do?"

MEASUREMENT

- Time (in sec) between end of question and end of answer.
- Accuracy, as indicated by answering RANGE in response to the item given above.
- Max = 1.

GUNNER MEASUREMENT

GNR MG PRE MTH/S TNK VIS 500-4400 DN GPD SBHT

PRE GNR: 1. ACQUIRES TARGETS

- TARGET ACQUISITION IS MEASURED AS PART OF THE ENABLING SKILLS IN THE OVERT RESPONSE PRE GNR 1.2., "SAY TANK AND ANNOUNCE ITS POSITION."

PRE GNR: 1.2. SAY TANK, AND ANNOUNCE ITS POSITION

SAMPLE TEST SCENARIO

- GNR overlooking simulation of rolling, partly wooded terrain is instructed to monitor his area of surveillance, and to say TANK and announce target position in response to tank targets, and to say nothing in response to other targets, friendlies, and "non-targets."

- Three moving tank targets, 2 moving other targets, 3 moving friendlies, and 2 moving NPT (no possible target; e.g., civilian vehicles) appear on terrain which contains 2 stationary tank targets, 3 stationary other targets, 2 stationary friendlies, and 3 stationary NPT, singly and in likely combinations, in random order, at the ranges given in the table below, within a total of 2 min, at various positions within the GNR's area of surveillance, at various angles of regard.

	TARGETS		F	NPT
	TANK	OTHER		
M	<400m 800-1199 1600-1999	400-799m 1200-1599	<400m 800-1199 1600-1999	400-799m 1200-1599
S	400-799 1200-1599	<400 800-1199 1600-1999	400-799 1200-1599	<400 800-1199 1600-1999

F = friendly, M = moving, S = stationary.
Ranges in meters.

MEASUREMENT

- Mean time (in sec) between appearance of tank targets and end of position announcements.

- Accuracy, as indicated by the response TANK and position announcement to tank targets, and by saying nothing in response to other targets, friendlies, and NPT.

- Max = 20 = 5 announcements of TANK and position, + 15 silences.

PRE GNR: 1.2.1. DISTINGUISHES BETWEEN PROSPECTIVE TARGETS AND OTHER ENVIRONMENTAL FEATURES

SAMPLE TEST SCENARIO

- GNR overlooking simulation of rolling, partly wooded terrain is instructed to monitor his area of surveillance and to say POSSIBLE in response to targets and friendlies, and nothing in response to NPT.

- Three moving targets, 2 moving friendlies, and 5 moving NPT ("no possible target"; e.g., civilian vehicles) appear on terrain which contains 2 stationary targets, 3 stationary friendlies and 5 stationary NPT (e.g., barns, houses), singly and in likely combinations, in random order, at the ranges given in the table below, within a total of 2 min, at various positions within the GNR's area of surveillance, at various angles of regard.

	T	F	NPT
M	<400m 800-1199 1600-1999	400-799m 1200-1599	<400m 400-799 800-1199 1200-1599 1600-1999
S	400-799 1200-1599	<400 800-1199 1600-1999	<400 400-799 800-1199 1200-1599 1600-1999

T = target, F = friendly, NPT = no possible target,
M = moving, S = stationary.
Ranges in meters.

MEASUREMENT

- Mean time (in sec) between appearance of prospective targets and GNR's saying POSSIBLE.

- Accuracy, as indicated by the response POSSIBLE to prospective targets, and by saying nothing in response to NPT.

- Max = 20 = 10 announcements of POSSIBLE + 10 silences.

PRE GNR: 1.2.2. DISTINGUISHES BETWEEN TARGETS AND FRIENDLIES

SAMPLE TEST SCENARIO

- **GNR overlooking simulation of rolling, partly wooded terrain is instructed to monitor his area of surveillance, and to say TARGET in response to targets, and nothing in response to friendlies.**

- **Five moving targets and 5 moving friendlies appear on terrain which contains 5 stationary targets and 5 stationary friendlies, singly and in likely combinations, in random order, at the ranges given in the table below, within a total of 2 min, at various positions within the GNR's area of surveillance, at various angles of regard.**

	T	F
M	<400m 400-799 800-1199 1200-1599 1600-1999	<400m 400-799 800-1199 1200-1599 1600-1999
S	<400 400-799 800-1199 1200-1599 1600-1999	<400 400-799 800-1199 1200-1599 1600-1999

T = target, F = friendly, M = moving, S = stationary. Ranges in meters.

MEASUREMENT

- **Mean time (in sec) between appearance of targets and GNR's saying TARGET.**

- **Accuracy, as indicated by the response TARGET to targets, and by saying nothing in response to friendlies.**

- **Max = 20 = 10 announcements of TARGET + 10 silences.**

PRE GNR: 1.2.3. DISTINGUISHES BETWEEN TANKS AND OTHER TARGETS

SAMPLE TEST SCENARIO

- GNR overlooking simulation of rolling, partly wooded terrain is instructed to monitor his area of surveillance, and to say YES in response to tank targets, and NO in response to other targets.

- Three moving Warsaw Pact tanks and 2 other moving targets appear on terrain which contains 2 stationary Warsaw Pact tanks and 3 other stationary targets, singly and in likely combinations, in random order, at the ranges given in the table below, within a total of 1 min, at various positions within the GNR's area of surveillance, at various angles of regard.

	TARGETS	
	TANKS	OTHER
M	<400m 800-1199 1600-1999	400-799m 1200-1599
S	400-799 1200-1599	<400 800-1199 1600-1999

M = moving, S = stationary.
Ranges in meters.

MEASUREMENT

- Mean time (in sec) between <u>appearance of targets</u> and <u>GNR's saying YES or NO</u>.

- Accuracy, as indicated by the responses YES to tank targets, and NO to other targets.

- Max = 10 = 5 YES + 5 NO.

PRE GNR: 1.2.4. DESCRIBES LOCATIONS OF OBJECTS IN TERMS OF POSITION ON A CLOCK FACE

SAMPLE TEST SCENARIO

- GNR overlooking simulation of rolling, partly wooded terrain is instructed to monitor his area of surveillance, and to report the positions of any targets he sees.
- Five moving targets appear singly on terrain which contains 5 stationary targets, at various ranges from 400 to 2000m, at various positions within the GNR's area of surveillance, at various angles of regard, within a total of 1 min.

MEASUREMENT

- Mean time (in sec) between appearance of targets and GNR's announcing target positions.
- Accuracy, as indicated by difference between actual and reported target positions.
- Max = 10.

PRE GNR: 1.2.5. RECALLS THAT TARGET'S POSITION MUST BE ANNOUNCED IMMEDIATELY AFTER SAYING TANK

SAMPLE TEST SCENARIO

- GNR is told, "You have identified a tank in your area of surveillance and have alerted the crew by announcing TANK"; and asked, "What do you do next?"

MEASUREMENT

- Time (in sec) between end of question and end of answer.
- Accuracy, as indicated by answering ANNOUNCE ITS POSITION (or LOCATION, or equivalent) to the item given above.
- Max = 1.

PRE GNR: 2. OPERATES MAIN GUN

SAMPLE TEST SCENARIO

- GNR in firing vehicle simulator is told to react to TC's (or examiner's) forthcoming fire commands.
- Main gun switch is OFF.
- Ten items or trials are administered in random order.
- In five of the trials, TC (or examiner) says GUNNER SABOT TANK, and gun tube swings from 30° off target to a position where a Warsaw Pact tank at >1600m appears on any one of the axes given by bisecting each of the four 90° angles of the aiming cross, at a point midway between the center of the aiming cross and the perimeter of the periscope's field of view. TC says FIRE 2 sec after GNR says IDENTIFIED.
- In five of the trials, the scenario outlined in the immediately preceding paragraph is repeated, except that TC (or examiner) begins each trial by saying GUNNER BATTLESIGHT TANK.

MEASUREMENT

- Mean time (in sec) between end of initial fire command and end of GNR's saying TARGET, LEFT, RIGHT, SHORT, or OVER.
- Accuracy, as indicated by:
    1. Turning main gun switch ON, saying IDENTIFIED, laying on center of vulnerability, waiting for TC to say FIRE, firing, and sensing round, in response to TC's saying GUNNER SABOT TANK. (All six components constitute one correct response.)
    2. Distance between intersection of periscope crosshairs and center of target vulnerability for precision trials only. (No measure of the accuracy is made for the five battlesight trials, as this is a test of the GNR's ability to operate the main gun in a precision engagement.)
- Max = 5, weighted for accuracy of lay.

PRE GNR: 2.1. TURN MAIN GUN SWITCH ON

SAMPLE TEST SCENARIO

- GNR in firing vehicle simulator is told that the TC (or examiner) will initiate a fire command in response to a target, that SABOT is indexed, and that he (GNR) is to do that part of his job which immediately follows the TC's fire command.
- Main gun switch is OFF.
- Gun tube is 30° off target.
- Warsaw Pact tank appears at >1600m.
- TC says GUNNER SABOT TANK.

MEASUREMENT

- Time (in sec) between end of TC's saying GUNNER SABOT TANK and closing main gun ON/OFF switch.
- Accuracy, as indicated by ON/OFF switch's being in ON position.
- Max = 1.

PRE GNR: 2.1.1. DISTINGUISHES AMONG MAIN GUN AND OTHER SWITCHES, AND BETWEEN ON AND OFF POSITIONS OF MAIN GUN SWITCH

SAMPLE TEST SCENARIO

- GNR is instructed to point to or mark main gun switch ON and OFF positions on representation of inside front of turret.

MEASUREMENT

- Mean time (in sec) between end of instructions and end of each response.
- Accuracy, as indicated by identifying switch, and identifying ON and OFF positions.
- Max = 2 = 1 for locating switch + 1 for identifying ON and OFF positions. No part credit is given for identifying ON position only or OFF position only; that is, examinee gets 1 or nothing for identifying ON and OFF positions. Thus the only possible numbers of correct responses are 0, 1, and 2:
  - 0 = switch not located.
  - 1 = switch located, with ON/OFF identification reversed, missing, or identical.
  - 2 = switch located, with ON/OFF identification correct.

PRE GNR: 2.1.2. RECALLS THAT TURNING MAIN GUN SWITCH ON IS RESPONSE TO TC'S SAYING GUNNER AND THE NAME OF A MAIN GUN ROUND, AND MAIN GUN SWITCH'S BEING IN OFF POSITION

SAMPLE TEST SCENARIO

- GNR is told, "The TC has begun a fire command by saying GUNNER and naming a main gun round; your main gun switch is OFF"; and asked, "What do you do?"

MEASUREMENT

- Time (in sec) between end of question and end of answer.
- Accuracy, as indicated by answering TURN MAIN GUN ON in response to the item given above.
- Max = 1.

PRE GNR: 2.2. LAY CROSSHAIRS AT CENTER OF TARGET VULNERABILITY

SAMPLE TEST SCENARIO

- GNR in firing vehicle simulator is told that the TC (or examiner) will initiate fire commands and lay gun for direction in response to various targets, and that he (GNR) is to do that part of his job which immediately follows the TC's firing command.
- Main gun switch is ON.
- The following sequence is repeated 5 times: TC says GUNNER SABOT TANK, gun traverses to target, and Warsaw Pact tank appears at various locations, apparent ranges, and angles of regard in the gunner's periscope.

MEASUREMENT

- Mean time (in sec) between appearance of target in periscope and a) end of GNR's saying IDENTIFIED, and b) end of gun movement.
- Accuracy, as indicated by:
    1. Saying IDENTIFIED and laying crosshairs. (Both components constitute one correct response.)
    2. Distance between intersection of periscope crosshairs and center of target vulnerability.
- Max = 5 correct responses, weighted for accuracy of lay.

PRE GNR: 2.2.1. RECALLS THAT LAYING CROSSHAIRS AT CENTER OF TARGET VULNERABILITY IS RESPONSE TO TC'S ANNOUNCING GUNNER AND MAIN GUN AMMUNITION, AND GNR'S SAYING IDENTIFIED

SAMPLE TEST SCENARIO

- GNR is told, "The TC has announced GUNNER SABOT TANK and laid the main gun for direction; you see the target in your periscope and say IDENTIFIED"; and asked, "What do you do next?"

MEASUREMENT

- Time (in sec) between end of question and end of answer.
- Accuracy, as indicated by answering LAY CROSSHAIRS AT CENTER OF TARGET VULNERABILITY in response to the item given above.
- Max = 1.

PRE GNR: 2.2.2. RECALLS PROCEDURE FOR LAYING CROSSHAIRS ON CENTER OF TARGET VULNERABILITY

SAMPLE TEST SCENARIO

- GNR is asked to state the steps in laying the periscope crosshairs on center of target vulnerability.

MEASUREMENT

- Mean time (in sec) between end of question and end of answer.
- Accuracy, as indicated by match between steps given by GNR and those shown on answer key.
- Max = Depends on key.

PRE GNR: 2.2.3. IDENTIFIES CENTER OF TARGET VULNERABILITY

SAMPLE TEST SCENARIO

. GNR is instructed to point to or mark the center of vulnerability on 20 representations of Warsaw Pact tanks, shown at various angles of regard, and at apparent ranges of 50 to 2500 m.

MEASUREMENT

. Mean time (in sec) between end of instructions and end of response.

. Accuracy, as indicated by distance between actual and indicated centers of vulnerability.

. Max = 20.

PRE GNR: 2.3. MAKE FINAL PRECISE LAY

SAMPLE TEST SCENARIO

- GNR in firing vehicle simulator is told that the TC (or examiner) will initiate fire commands and lay gun for direction in response to various targets, and that he (GNR) is to locate each target in his periscope, say IDENTIFIED, and do that part of his job which immediately follows the saying IDENTIFIED.
- Main gun switch is ON.
- The following sequence is repeated 5 times: TC says GUNNER SABOT TANK, gun traverses to target, and Warsaw Pact tank appears at various locations, apparent ranges, and angles of regard in the gunner's periscope.

MEASUREMENT

- Mean time (in sec) between <u>appearance of target in periscope</u> and <u>end of gun movement</u>.
- Accuracy, as indicated by
    1. Saying IDENTIFIED and laying crosshairs. (Both components constitute one correct response.)
    2. Distance between intersection of periscope crosshairs and center of target vulnerability.
- Max = 5 correct responses, weighted for accuracy of lay.

PRE GNR: 2.3.1. RECALLS THAT MAKING FINAL PRECISE LAY IS RESPONSE TO SAYING IDENTIFIED AND CROSSHAIRS' NOT BEING ON CENTER OF TARGET VULNERABILITY

SAMPLE TEST SCENARIO

- GNR is told, "The TC has announced GUNNER SABOT TANK, and has laid the main gun for direction; you see the target in your periscope and say IDENTIFIED"; and is asked, "What do you do next?"

MEASUREMENT

- Time (in sec) between end of question and end of answer.
- Accuracy, as indicated by answering MAKE PRECISE LAY (or LAY CROSSHAIRS ON TARGET, or equivalent) in response to the item given above.
- Max = 1.

PRE GNR: 2.3.2. OPERATES POWER CONTROL HANDLE

SAMPLE TEST SCENARIO

- GNR in turret or simulation of turret with operational power control handle is instructed to TRAVERSE LEFT, TRAVERSE RIGHT, DEPRESS, ELEVATE.

MEASUREMENT

- Mean time (in sec) between end of each command and initiation of movement in direction indicated by command.
- Accuracy, as indicated by difference in number of degrees between line traversed by gun and horizontal or vertical.
- Max = 4.

PRE GNR: 2.4. FIRE MAIN GUN

SAMPLE TEST SCENARIO

- GNR in firing vehicle simulator is instructed to look in periscope, and upon seeing a target, to say IDENTIFIED, and to do that part of his job which immediately follows saying IDENTIFIED in a precision engagement.
- Warsaw Pact tank at >1600m appears at any one of the axes given by bisecting each of the four 90° angles of the aiming cross, at a point midway between the center of the aiming cross and the perimeter of the periscope field of view.

MEASUREMENT

- Time (in sec) between end of saying IDENTIFIED and end of saying ON THE WAY.
- Accuracy, as indicated by:
    1. Saying IDENTIFIED, laying crosshairs, saying ON THE WAY, and firing. (All four components constitute one correct response).
    2. Distance between intersection of periscope crosshairs and center of target vulnerability.
- Max = one correct response, weighted for accuracy of lay.

PRE GNR: 2.4.1. RECALLS THAT FIRING IS RESPONSE TO SAYING ON THE WAY

SAMPLE TEST SCENARIO

- GNR is told, "The TC has announced GUNNER SABOT TANK, and has laid the main gun for direction; you have seen the target in your periscope, said IDENTIFIED, made a final precise lay; the TC has said FIRE, you have said ON THE WAY"; and is asked, "What do you do next?"

MEASUREMENT

- Time (in sec) between end of question and end of answer.
- Accuracy, as indicated by answering FIRE in response to the item given above.
- Max = 1.

PRE GNR: 2.4.2. RECALLS PROCEDURE FOR FIRING

SAMPLE TEST SCENARIO

. GNR is asked to state steps in firing.

MEASUREMENT

. Mean time (in sec) between end of question and end of answer.

. Accuracy, as indicated by match between steps given by GNR and those shown on answer key.

. Max = Depends on key.

PRE GNR: 3. RESPONDS TO FIRE COMMANDS

SAMPLE TEST SCENARIO

- GNR in firing vehicle simulator is told to react to TC's forthcoming fire commands.
- Ten items or trials are administered in random order, with the gun tube 30° off target at the start of each.
- The TC (or examiner) says GUNNER SABOT TANK, and the gun tube swings 30° at the start of each trial. In two of the ten trials, no target appears in the periscope. Upon hearing the GNR say CANNOT IDENTIFY, TC says FROM MY POSITION. A target then appears in the periscope and the TC fires.
- In eight of the ten trials a Warsaw Pact tank at >1600m appears on any one of the axes given by bisecting each of the four 90° angles of the aiming cross, at a point midway between the center of the aiming cross and the perimeter of the periscope's field of view. After GNR says IDENTIFIED, TC waits 2 sec, and:
  - .. In two of the eight trials says AT MY COMMAND, waits 5 sec, and says FIRE.
  - .. In one of the eight trials says nothing for 10 more sec, then says FIRE.
  - .. In five of the eight trials says FIRE.

MEASUREMENT

- Mean time (in sec) between <u>end of TC's saying GUNNER SABOT TANK</u> and <u>end of GNR's saying TARGET, LEFT, RIGHT, SHORT, or OVER</u>.
- Accuracy, as indicated by:
  1. Saying CANNOT IDENTIFY, removing hands from controls, and sensing round in response to not seeing a target in the periscope. (All three components constitute one correct response.)
  2. Saying IDENTIFIED, laying periscope cross-hairs on center of target vulnerability, waiting for TC to say FIRE, saying ON THE WAY, FIRING, and sensing round, in response to seeing target in periscope, and TC's saying FIRE. (All six components constitute one correct response.)

3. Distance between intersection of periscope crosshairs and center of target vulnerability.

4. Correspondence between GNR's sensing announcements and positions of rounds relative to targets.

. Max = 10, weighted for accuracy of lay and sensing.

PRE GNR: 3.1. SAY IDENTIFIED

SAMPLE TEST SCENARIO

. GNR in turret simulator is told to react to TC's forthcoming fire command. TC then says GUNNER SABOT TANK, and gun tube swings from 30° off target to a position where a Warsaw Pact tank at >1600m appears on any one of the axes given by bisecting each of the four 90° angles of the aiming cross, at a point midway between the center of the aiming cross and the perimeter of the periscope's field of view.

MEASUREMENT

. Time (in sec) between beginning of target's intersecting the perimeter of the periscope's field of view and end of GNR's saying IDENTIFIED.

. Accuracy, as indicated by saying IDENTIFIED in response to the target's intersecting the perimeter of the periscope's field of view.

. Max = 1.

PRE GNR: 3.1.1. RECALLS THAT SAYING IDENTIFIED IS RESPONSE TO TC'S SAYING GUNNER, AND [GNR'S] SEEING THE TARGET, AND LDR'S SAYING UP

SAMPLE TEST SCENARIO

. GNR is told, "The TC has said GUNNER; you have looked in your periscope and seen the target; and the LDR has said UP"; and is asked, "What do you do next?"

MEASUREMENT

. Time (in sec) between end of question and end of answer.

. Accuracy, as indicated by answering SAY IDENTIFIED in response to the item given above.

. Max = 1.

PRE GNR: 3.2. SAY CANNOT IDENTIFY

SAMPLE TEST SCENARIO

. GNR in turret simulator is told to react to TC's forthcoming fire command. TC then says GUNNER SABOT TANK. Gun tube then swings 30° and stops. No target appears in the periscope.

MEASUREMENT

. Time (in sec) between gun tube's stopping and GNR's saying CANNOT IDENTIFY.

. Accuracy, as indicated by saying CANNOT IDENTIFY in response to not seeing a target.

. Max = 1.

PRE GNR: 3.2.1. RECALLS THAT SAYING CANNOT IDENTIFY IS RESPONSE TO TC'S SAYING GUNNER, AND [GNR'S] NOT SEEING THE TARGET

SAMPLE TEST SCENARIO

- GNR is told, "The TC has said GUNNER; you have looked in your periscope, and cannot see the target"; and is asked, "What do you do next?"

MEASUREMENT

- Time (in sec) between end of question and end of answer.
- Accuracy, as indicated by answering SAY CANNOT IDENTIFY in response to the item given above.[1]
- Max = 1.

[1] If GNR answers, "Keep looking," or equivalent, examiner will reply, "Suppose you continue looking and still can't see the target."

PRE GNR: 3.3. SAY ON THE WAY

SAMPLE TEST SCENARIO

- GNR in turret simulator is told to find target in periscope, say IDENTIFIED, lay crosshairs on center of target vulnerability, and react to TC's forthcoming fire command.
- Warsaw Pact tank at >1600m appears on any one of the axes given by bisecting each of the four 90° angles of the aiming cross, at a point midway between the center of the aiming cross and the perimeter of the periscope's field of view.
- TC says FIRE immediately after GNR says IDENTIFIED.

MEASUREMENT

- Time (in sec) between end of TC's saying FIRE and end of GNR's saying ON THE WAY.
- Accuracy, as indicated by:
    1. *Saying* ON THE WAY in response to TC's saying FIRE.
    2. Distance between intersection of periscope crosshairs and center of target vulnerability.
- Max = one correct response, weighted for accuracy of lay.

PRE GNR: 3.3.1. RECALLS THAT SAYING ON THE WAY IS RESPONSE TO CROSSHAIRS' BEING ON CENTER OF TARGET VULNERABILITY, AND TC'S SAYING FIRE

SAMPLE TEST SCENARIO

- GNR is told, "The TC has said GUNNER SABOT TANK and laid the main gun for direction; you have said IDENTIFIED and laid the periscope crosshairs at the center of target vulnerability; the TC says FIRE"; and is asked, "What do you do next?"

MEASUREMENT

- Time (in sec) between end of question and end of answer.
- Accuracy, as indicated by answering SAY ON THE WAY in response to the item given above.
- Max = 1.

PRE GNR: 3.4. WAIT FOR TC TO SAY FIRE

SAMPLE TEST SCENARIO

- GNR in turret simulator is told to find target in periscope, say IDENTIFIED, lay crosshairs on center of target vulnerability, and react to TC's forthcoming fire command.
- Warsaw Pact tank at >1600m appears on any one of the axes given by bisecting each of the four 90° angles of the aiming cross, at a point midway between the center of the aiming cross and the perimeter of the periscope's field of view.
- In one trial, TC says AT MY COMMAND immediately after GNR says IDENTIFIED; in another, TC says nothing after GNR says IDENTIFIED.

MEASUREMENT

- Accuracy, as indicated by saying IDENTIFIED, laying periscope crosshairs at center of target vulnerability, and doing nothing more for 15 sec, in response to TC's saying AT MY COMMAND or nothing. (All three components--saying IDENTIFIED, laying crosshairs, and waiting 15 sec--constitute one correct response.
- Max = 2, weighted for accuracy of lay.

PRE GNR: 3.4.1. RECALLS THAT WAITING FOR TC TO SAY FIRE IS RESPONSE TO TC'S SAYING AT MY COMMAND, OR NOTHING

SAMPLE TEST SCENARIO

. GNR is told, "The TC has said GUNNER SABOT TANK; you have seen the target in the periscope, said IDENTIFIED, and made a final precise lay"; and asked:

1. "If the TC then says nothing, what do you do?"
2. "If the TC then says AT MY COMMAND, what do you do?"

MEASUREMENT

. Mean time (in sec) between end of each question and end of each answer.

. Accuracy, as indicated by answering WAIT FOR TC TO SAY FIRE in response to each of the two items given above.

. Max = 2.

PRE GNR: 3.5. RELAX GRIP ON CONTROLS

SAMPLE TEST SCENARIO

- GNR in turret simulator is told that TC will say FROM MY POSITION before firing, and that he [GNR] is to do that part of his job which immediately follows TC's saying FROM MY POSITION. TC then says FROM MY POSITION.

MEASUREMENT

- Time (in sec) between end of TC's saying FROM MY POSITION and GNR's relaxing grip on controls.
- Accuracy, as indicated by removing hands from controls in response to TC's saying FROM MY POSITION.
- Max = 1.

PRE GNR: 3.5.1. RECALLS THAT RELAXING GRIP ON CONTROLS IS RESPONSE TO TC'S SAYING FROM MY POSITION

SAMPLE TEST SCENARIO

- GNR is told, "The TC has said GUNNER SABOT TANK; you have seen the target in the periscope, said IDENTIFIED, and made a final precise lay; the TC then says FROM MY POSITION"; and asks, "What do you do next?"

MEASUREMENT

- Time (in sec) between end of question and end of answer.
- Accuracy, as indicated by answering RELAX GRIP ON CONTROLS (or POWER CONTROL HANDLE, or equivalent) in response to the item given above.
- Max = 1.

PRE GNR: 3.6. ANNOUNCE SENSING

SAMPLE TEST SCENARIO

- GNR in firing vehicle simulator is told that TC will say FROM MY POSITION and fire; and that he [GNR] is to do that part of his job which immediately follows TC's saying FROM MY POSITION. TC then says FROM MY POSITION and fires, hitting Warsaw Pact tank at >1600m.

- Sequence outlined above is repeated eight more times, but with TC missing over and short line; over, doubtful, and short left; and over, doubtful, and short right.

MEASUREMENT

- Mean time (in sec) between TC's firing and GNR's announcing TARGET, SHORT, OVER, OVER LEFT, OVER RIGHT, SHORT LEFT, SHORT RIGHT, DOUBTFUL LEFT, or DOUBTFUL RIGHT.

- Accuracy, as indicated by relaxing grip on controls, and correspondence between GNR's announcements and positions of rounds relative to targets. (Both components constitute one correct response.)

- Max = 9.

PRE GNR: 3.6.1. RECALLS THAT SENSING ROUND IS RESPONSE TO TC'S FIRING

SAMPLE TEST SCENARIO

- GNR is told, "The TC has said GUNNER SABOT TANK; you have seen the target in the periscope, said IDENTIFIED, and made a final precise lay; the TC then says FROM MY POSITION and fires"; and asked, "What do you do next?"

MEASUREMENT

- Time (in sec) between end of question and end of answer.
- Accuracy, as indicated by answering SENSE ROUND or ANNOUNCE SENSING in response to the items given above.
- Max = 1.

PRE GNR: 3.6.2. RECALLS PROCEDURE FOR SENSING ROUND

SAMPLE TEST SCENARIO

. GNR is asked to state steps in sensing round.

MEASUREMENT

. Mean time (in sec) between end of question and end of answer.

. Accuracy, as indicated by match between steps given by GNR and those shown in answer key.

. Max = Depends on key.

DRIVER MEASUREMENT

GNR MG PRE MTH/S TNK VIS 500-4400 GN GPD SBHT

PRE DVR: 1. RESPONDS TO FIRE COMMANDS

SAMPLE TEST SCENARIO

- DVR in firing vehicle or simulator, which is in the center of rolling, partly wooded terrain (or simulation) measuring 100m x 100m and containing three defilade (hull-down) positions, is told to react to TC's (or examiner's) forthcoming fire command.
- TC (or examiner) says GUNNER SABOT TANK.
- Three Warsaw Pact tanks begin firing on test vehicle.
- TC (or examiner) says DRIVER SEEK HULL DEFILADE.
- LDR (or examiner) says UP while test vehicle is moving to defilade.
- GNR (or examiner) says ON THE WAY immediately after test vehicle stops.
- Main gun fires.

MEASUREMENT

- Time (in sec) between end of TC's (or examiner's) saying GUNNER SABOT TANK and end of test vehicle's motion.
- Accuracy, as indicated by arriving at defilade without being hit, braking smoothly, and applying brakes for firing. (All four components--defilade, no hit, smooth braking, and braking for firing--constitute one correct response.
- Max = 1.

PRE DVR: 1.1. MANEUVER FOR FIRING

SAMPLE TEST SCENARIO

- DVR in firing vehicle simulator on simulation of rolling, partly wooded terrain is told a) a destination to drive to, and b) to react to TC's (or examiner's) forthcoming fire command. Destination can be reached by any of several routes, only one of which has sufficient cover and concealment to allow reaching the destination without taking a hit.

- TC (or examiner) says GUNNER SABOT TANK.

- Three Warsaw Pact tanks open fire on DVR's vehicle.

MEASUREMENT

- Time (in sec) between end of fire command and arrival at destination.

- Accuracy, as indicated by arriving at destination without being hit.

- Max = 1.

PRE DVR: 1.1.1. DRIVES TANK EVASIVELY

SAMPLE TEST SCENARIO

- DVR in firing vehicle simulator on simulation of rolling, partly wooded terrain is fired upon by three Warsaw Pact tanks. TC (or examiner) instructs DVR to drive to a given destination, which can be reached by any of several routes, only one of which has sufficient cover and concealment to allow reaching the destination without taking a hit.

MEASUREMENT

- Time (in sec) between end of instructions to move to destination and arrival at destination.
- Accuracy, as indicated by arriving at destination without being hit.
- Max = 1.

PRE DVR: 1.1.2. RECALLS THAT MANEUVERING FOR FIRING IS RESPONSE TO AN AMMO ELEMENT IN THE FIRE COMMAND AND THE FIRING VEHICLE'S MOVING

SAMPLE TEST SCENARIO

- DVR is told, "You are driving a tank across rolling, partly wooded terrain, and the TC has begun a fire command which contains an ammo element--for example, GUNNER SABOT"; and asked, "What is the first thing you do?"

MEASUREMENT

- Time (in sec) between end of question and end of answer.
- Accuracy, as indicated by answering MANEUVER FOR FIRING (or equivalent) in response to the item given above.
- Max = 1.

PRE DVR: 1.2. MOVE TO HULL-DOWN POSITION

SAMPLE TEST SCENARIO

- DVR in firing vehicle or simulator, which is in the center of rolling, partly wooded terrain (or simulation) measuring 100m x 100m and containing three defilade (hull-down) positions, is told to react to TC's (or examiner's) forthcoming fire command.
- TC (or examiner) says GUNNER SABOT TANK.
- Three Warsaw Pact tanks begin firing on test vehicle.
- TC (or examiner) says DRIVER SEEK HULL DEFILADE.

MEASUREMENT

- Time (in sec) between end of TC's (or examiner's) saying DRIVER SEEK HULL DEFILADE and end of test vehicle's motion.
- Accuracy, as indicated by arriving at defilade position without being hit.
- Max = 1.

PRE DVR: 1.2. MOVE TO HULL-DOWN POSITION

SAMPLE TEST SCENARIO

- DVR in firing vehicle or simulator, which is in the center of rolling, partly wooded terrain (or simulation) measuring 100m x 100m and containing three defilade (hull-down) positions, is told to react to TC's (or examiner's) forthcoming fire command.
- TC (or examiner) says GUNNER SABOT TANK.
- Three Warsaw Pact tanks begin firing on test vehicle.
- TC (or examiner) says DRIVER SEEK HULL DEFILADE.

MEASUREMENT

- Time (in sec) between end of TC's (or examiner's) saying DRIVER SEEK HULL DEFILADE and end of test vehicle's motion.
- Accuracy, as indicated by arriving at defilade position without being hit.
- Max = 1.

PRE DVR: 1.2.1. LOCATES DEFILADE POSITIONS

SAMPLE TEST SCENARIO

- DVR in firing vehicle or simulator, which is in the center of rolling, partly wooded terrain (or simulation) measuring 100m x 100m and containing three defilade (hull-down) positions, is asked to locate all defilade positions in the square.

MEASUREMENT

- Mean time (in sec) between end of question and end of answer.
- Accuracy, as indicated by correspondence between DVR's answers and locations of defilade positions.
- Max = 3 = 1 for each correct location.

PRE DVR: 1.2.2. DRIVES TANK EVASIVELY

SAMPLE TEST SCENARIO

. See PRE DVR 1.1.1.

MEASUREMENT

. See PRE DVR 1.1.1.

PRE DVR: 1.2.3. RECALLS THAT MOVING TO HULL-DOWN POSITION IS RESPONSE TO TC'S SAYING DRIVER SEEK HULL DEFILADE, AND FIRING VEHICLE'S NOT BEING IN HULL-DOWN POSITION

SAMPLE TEST SCENARIO

- DVR is told, "You are driving a tank across rolling, partly wooded terrain, and the TC says DRIVER SEEK HULL DEFILADE"; and asked, "What do you do next?"

MEASUREMENT

- Time (in sec) between end of question and end of answer.
- Accuracy, as indicated by answering MOVE TO HULL-DOWN POSITION (or LOOK FOR DEFILADE, or equivalent) in response to the item given above.
- Max = 1.

PRE DVR: 1.3. BRING TANK TO GRADUAL HALT

SAMPLE TEST SCENARIO

- DVR in firing vehicle or simulator, which is in the center of rolling, partly wooded terrain (or simulation) measuring 100m x 100m and containing three defilade (hull-down) positions, is told to react to TC's (or examiner's) forthcoming fire command.
- TC (or examiner) says GUNNER SABOT TANK.
- Three Warsaw Pact tanks begin firing on test vehicle.
- TC (or examiner) says DRIVER STOP.

MEASUREMENT

- Time (in sec) between arrival at defilade position and end of test vehicle's motion.
- Accuracy: See PRE DVR 1.3.1. for possible measures.
- Max = 1, weighted for deviation from optimal.

PRE DVR: 1.3.1. BRAKES SMOOTHLY

SAMPLE TEST SCENARIO

- DVR in firing vehicle or simulator traversing rolling, partly wooded terrain at 10 mph is instructed to brake smoothly. Procedure is repeated for 5, 15, and 20 mph.

MEASUREMENT

- Mean time (in sec) between end of instructions and end of firing vehicle's motion.
- Accuracy: will have to be defined in terms of separate deceleration equations for each speed, or possibly in terms of total deviation of a fixed reference point on the firing vehicle from an imaginary line to an external reference point (a target, for example).
- Max = 4, weighted for deviation from optimal.

PRE DVR: 1.3.2. RECALLS THAT BRAKING SMOOTHLY IMMEDIATELY FOLLOWS MOVING TO HULL-DOWN POSITION

SAMPLE TEST SCENARIO

- DVR is told, "While you are driving across rolling terrain, your TC announces DRIVER STOP, and you move to a hull-down position"; and asked, "What do you do next?"

MEASUREMENT

- Time (in sec) between end of question and end of answer.
- Accuracy, as indicated by answering BRAKE SMOOTHLY (or APPLY BRAKES, or equivalent) in response to the item given above.
- Max = 1.

PRE DVR: 1.4. APPLY BRAKES FOR FIRING

SAMPLE TEST SCENARIO

- DVR in firing vehicle or simulator, which is in the center of rolling, partly wooded terrain (or simulation) measuring 100m x 100m and containing three defilade (hull-down) positions, is told to react to TC's (or examiner's) forthcoming fire command.
- TC (or examiner) says GUNNER SABOT TANK.
- Three Warsaw Pact tanks begin firing on test vehicle.
- TC (or examiner) says DRIVER STOP.
- LDR (or examiner) says UP while test vehicle is moving to defilade.
- GNR (or examiner) says ON THE WAY immediately after test vehicle stops.
- Main gun fires.

MEASUREMENT

- Time (in sec) between end of GNR's (or examiner's) saying ON THE WAY and brake pedal pressure's reading ___ psi.*
- Accuracy, as indicated by pedal pressure's reaching ___psi* before main gun fires.
- Max = 1.

---

*Values will have to be determined empirically.

PRE DVR: 1.4.1. RECALLS THAT APPLYING BRAKES FOR FIRING IMMEDIATELY FOLLOWS BRAKING SMOOTHLY

SAMPLE TEST SCENARIO

- DVR is told, "While you are driving across rolling terrain, your TC announces DRIVER STOP, and you move to a hull-down position and brake smoothly"; and asked, "What do you do next?"

MEASUREMENT

- Time (in sec) between end of question and end of answer.
- Accuracy, as indicated by answering APPLY BRAKES FOR FIRING (or BRAKE FOR FIRING, or equivalent) in response to the item given above.
- Max = 1.

PRE DVR: 2. RESPONDS TO ADVERSE TERRAIN CONDITIONS

SAMPLE TEST SCENARIO

- DVR in firing vehicle simulator on simulation of rolling, partly wooded terrain is told a) a destination to drive to, and b) to react to TC's (or examiner's) instructions. The only route to the destination contains a swamp.
- TC (or examiner), on hearing DVR's description of the obstacle, redirects DVR to a route containing fallen trees.
- TC (or examiner), on hearing DVR's description of the obstacles, redirects DVR to a route containing a big ditch.
- TC (or examiner), on hearing DVR's description of the obstacle, redirects DVR to destination.

MEASUREMENT

- Mean time (in sec) between end of initial instructions and arrival at destination.
- Accuracy, as indicated by the announcements SWAMP, TREES, DITCH (or equivalent), and arrival at destination *via* routes prescribed by TC or examiner.
- Max = 6 = 3 announcements of obstacles + 3 correct responses to directions for avoiding obstacles.

PRE DVR: 2.1. DESCRIBE ADVERSE TERRAIN CONDITIONS

SAMPLE TEST SCENARIO

. DVR in firing vehicle simulator or simulation of rolling, partly wooded terrain is told a destination to drive to. The only route to the destination contains a swamp.

MEASUREMENT

. Time (in sec) between appearance of swamp and DVR's announcement.

. Accuracy, as indicated by DVR's saying SWAMP (or WATER, or equivalent) in response to appearance of swamp.

. Max = 1.

PRE DVR: 2.1.1. LOCATES TERRAIN CONDITIONS THAT WOULD, IF TRAVERSED, AFFECT OTHER CREW MEMBERS' PERFORMANCE ADVERSELY

SAMPLE TEST SCENARIO

- DVR in firing vehicle or simulator, which is in the center of rolling, partly wooded terrain (or simulation) measuring 100m x 100m and containing a swamp and a large ditch, is asked to locate terrain conditions that would, if traversed, have adverse effects on the crew's performance.

MEASUREMENT

- Mean time (in sec) between <u>end of question</u> and <u>end of answer</u>.
- Accuracy, as indicated by correspondence between DVR's answers, and locations of swamp and ditch.
- Max = 2 = 1 for each correct location.

PRE DVR: 2.1.2. RECALLS THAT DESCRIBING TERRAIN IS RESPONSE TO ADVERSE TERRAIN CONDITIONS AND NECESSITY TO TRAVERSE THEM

SAMPLE TEST SCENARIO

- DVR is told, "You are driving a tank cross country, and notice adverse terrain conditions in the route you are taking--a swamp, for example or a big ditch or anything that might degrade your crew's performance"; and asked, "What do you do next?"

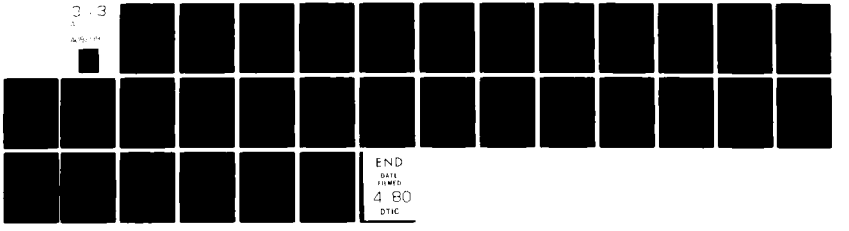
MEASUREMENT

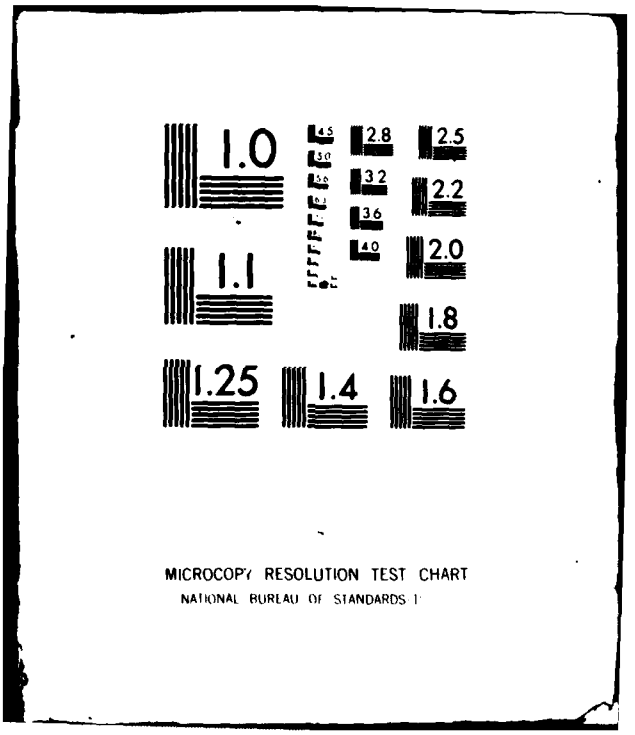
- Time (in sec) between end of question and end of answer.
- Accuracy, as indicated by answering DESCRIBE CONDITIONS (or ANNOUNCE SWAMP, or equivalent) in response to the item given above.
- Max = 1.

LOADER MEASUREMENT

GNR MG PRE MTH/S TNK VIS 500-4400 DN GPD SBHT

AD-A082 090 HUMAN RESOURCES RESEARCH ORGANIZATION ALEXANDRIA VA F/G 5/9
ANALYZING TANK GUNNERY ENGAGEMENTS FOR SIMULATOR-BASED PROCESS --ETC(U)
SEP 79 J A BOLDOVICI DAHC19-76-C-0001
UNCLASSIFIED HUMRRO-FR-WD(KY)-78-4 ARI-RR-1227 NL




1.0
1.1
1.25
1.4
1.6
1.8
2.0
2.2
2.5
2.8
3.2
3.6
4.0
MICROCOPY RESOLUTION TEST CHART
NATIONAL BUREAU OF STANDARDS 1

PRE LDR: 1. RESPONDS TO FIRE COMMANDS[1]

SAMPLE TEST SCENARIO

- M60A1 or simulator is loaded with half the number of each kind of round specified in a typical (European) loading plan. All ready racks are locked. Half the racks for each kind of round are empty.
- Main gun safety is in FIRE.
- LDR is told to load one round of SABOT, and is told to study a loading plan which shows the kinds, numbers, and locations of ammo in the tank or simulator. Two hours later (more if feasible), he is told to react to the TC's (or examiner's) forthcoming fire command.
- TC (or examiner) says GUNNER HEAT.

MEASUREMENT

- Time (in sec) between <u>end of fire command</u> and <u>LDR's saying UP</u>.
- Accuracy, as indicated by:
    1. Putting safety in SAFE.
    2. Unlocking empty SABOT ready rack.
    3. Unloading SABOT round.
    4. Putting unloaded SABOT in unlocked ready rack.

---

[1]All of the LDR's unloading responses addressed here are contingent upon his noticing a difference between the name of a round in a fire command and the kind of round in the main gun. Noticing this difference in turn requires the LDR to recall the name of the round in the main gun (usually SABOT). Testing the LDR's recall of the name of the round in the chamber requires that some time elapse between the time when he loads the main gun and the time when he is required to recall the name of the round. How long this elapsed time would be in combat cannot be known, but it probably would be considerable, since changing rounds in the main gun is not done frequently. An elapsed time of no less than 2 hr is arbitrarily recommended for testing purposes, with increases to 8 hr, depending on feasibility. The amount of elapsed time should in any event be identical for all examinees.

5. Locking SABOT in ready rack.

6. Unlocking rack containing HEAT.

7. Removing HEAT from unlocked rack.

8. Loading HEAT round.

9. Standing clear.

10. Putting safety in FIRE.

11. Saying UP.

(All 11 components constitute one correct response.)

. Max = 1.

PRE LDR: 1.1. PLACE SAFETY IN SAFE

SAMPLE TEST SCENARIO

- LDR in firing vehicle simulator is told to load one round of SABOT. Two hours later (more if feasible) he is told to react to the TC's (or examiner's) forthcoming fire command.
- Main gun safety is in FIRE.
- TC (or examiner) says GUNNER HEAT.

MEASUREMENT

- Time (in sec) between end of fire command and opening main gun safety switch.
- Accuracy, as indicated by safety's being in SAFE.
- Max = 1.

PRE LDR: 1.1.1. RECALLS NAME OF ROUND IN CHAMBER

SAMPLE TEST SCENARIO

- LDR in firing vehicle simulator is told to load one round of SABOT. Two hours later (more, if feasible) he is asked, "What kind of round did you load earlier?"

MEASUREMENT

- Time (in sec) between end of question and end of answer.
- Accuracy, as indicated by answering SABOT in response to the item given above.
- Max = 1.

PRE LDR: 1.1.2. NOTICES DIFFERENCE BETWEEN NAME OF ROUND IN CHAMBER AND ROUND IN FIRE COMMAND

SAMPLE TEST SCENARIO

. LDR in firing vehicle simulator is told to load one round of SABOT. Two hours later (more if feasible) he is asked whether the rounds named in the following partial fire commands are the same as or different from the round in the chamber:

1. GUNNER HEAT
2. GUNNER HEP
3. GUNNER SMOKE
4. GUNNER SABOT

MEASUREMENT

. Time (in sec) between end of questions and end of answers.

. Accuracy, as indicated by answering DIFFERENT in response to the first three items given above, and SAME in response to the fourth. (All four correct answers constitute one correct response; otherwise examinee could get three-quarters credit for answering DIFFERENT to all items.)

. Max = 1.

PRE LDR: 1.1.3: RECALLS THAT PLACING MAIN GUN SAFETY IN SAFE IS RESPONSE TO *DIFFERENCE* BETWEEN NAME OF ROUND IN CHAMBER AND ROUND IN FIRE COMMAND, AND SAFETY'S BEING IN FIRE

SAMPLE TEST SCENARIO

- LDR is told, "The TC has begun a fire command by saying GUNNER SMOKE; your main gun is loaded with SABOT, and the safety switch is in FIRE"; and asked, "What is the first thing you do?"

MEASUREMENT

- Time (in sec) between end of questions and end of answer.
- Accuracy, as indicated by answering PUT SAFETY IN SAFE in response to the item given above.
- Max = 1.

PRE LDR: 1.1.4. DISTINGUISHES AMONG TYPES OF AMMO BY INSPECTION

SAMPLE TEST SCENARIO

. LDR in M60A1 or simulator with ammo in ready racks is instructed to point to SABOT. Procedure is repeated for HEAT, BEEHIVE, HEP, SMOKE, and COAX.

MEASUREMENT

. Mean time (in sec) between end of instructions and end of each response.

. Accuracy, as indicated by pointing to each round in response to instructions to do so.

. Max = 6.

PRE LDR: 1.1.5. DISTINGUISHES AMONG MAIN GUN SAFETY SWITCH OR LEVER AND OTHER SWITCHES OR LEVERS, AND BETWEEN SAFE AND FIRE POSITIONS OF MAIN GUN SAFETY SWITCH OR LEVER

SAMPLE TEST SCENARIO

- LDR is instructed to point to or mark main gun safety switch SAFE and FIRE positions on representation of inside front of turret.

MEASUREMENT

- Mean time (in sec) between end of instructions and end of each response.
- Accuracy, as indicated by identifying switch, and identifying SAFE and FIRE positions.
- Max = 2 = 1 for locating switch + 1 for identifying SAFE and FIRE positions. No part credit is given for identifying SAFE position only or FIRE position only; that is, examinee gets 1 or nothing for identifying SAFE and FIRE positions. Thus, the only possible numbers of correct responses are 0, 1, and 2:
  - 0 = switch not located.
  - 1 = switch located, with SAFE/FIRE identification reversed, missing, or identical.
  - 2 = switch located, with SAFE/FIRE identification correct.

PRE LDR: 1.2. UNLOCK READY RACK

SAMPLE TEST SCENARIO

- M60A1 or simulator is loaded with half the number of each kind of round specified in a typical (European) loading plan. All ready racks are locked. Half the racks for each kind of round are empty.
- Main gun safety is in FIRE.
- LDR is told to load one round of SABOT, and is told to study a loading plan which shows the kinds, numbers, and locations of ammo in the tank or simulator. Two hours later (more if feasible), he is told to react to the TC's (or examiner's) forthcoming fire command.
- TC (or examiner) says GUNNER BEEHIVE.

MEASUREMENT

- Time (in sec) between opening main gun safety switch and unlocking ready rack.
- Accuracy, as indicated by:
    1. Safety's being in FIRE.
    2. Ready rack's being: a) unlocked, b) empty, and c) designated SABOT in the load plan. (All three conditions are necessary for one correct response.)
- Max = 1.

PRE LDR: 1.2.1. RECALLS THAT UNLOCKING READY RACK IS RESPONSE TO PLACING SAFETY IN SAFE, AND READY RACK'S BEING UNLOCKED

SAMPLE TEST SCENARIO

- LDR is told, "The TC has begun a fire command which will require you to unload SABOT from the main gun, and load SMOKE; you have put the main gun safety in safe, and the ready rack is locked"; and asked, "What do you do next?"

MEASUREMENT

- Time (in sec) between end of question and end of answer.
- Accuracy, as indicated by answering UNLOCK READY RACK in response to the item given above.
- Max = 1.

PRE LDR: 1.2.2. LOCATES READY RACK WHERE UNLOADED ROUND WILL BE STORED

SAMPLE TEST SCENARIO

- M60A1 or simulator is loaded with half the number of each kind of round specified in a typical (European) loading plan. Half the ready racks for each kind of round are empty.
- LDR is told that TC has begun a fire command which will require unloading SABOT and loading HEP, and is instructed to point to the ready rack where the unloaded SABOT should be put. Procedure is repeated with the following substitutions for SABOT and HEP: HEP and HEAT, HEAT and SMOKE, BEEHIVE and SABOT, and SMOKE and SABOT.

MEASUREMENT

- Mean time (in sec) between end of instructions and end of each response.
- Accuracy, as indicated by pointing to correct ready racks in response to the instructions given above.
- Max = 5.

PRE LDR: 1.3. UNLOAD MAIN GUN

SAMPLE TEST SCENARIO

- M60A1 or simulator is loaded with half the number of each kind of round specified in a typical (European) loading plan. All ready racks are locked. Half the racks for each kind of round are empty.
- Main gun safety is in FIRE.
- LDR is told to load one round of SABOT, and is told to study a loading plan which shows the kinds, numbers, and locations of ammo in the tank or simulator. Two hours later (more if feasible), he is told to react to the TC's (or examiner's) forthcoming fire command.
- TC (or examiner) says GUNNER HEP.

MEASUREMENT

- Time (in sec) between end of unlocking ready rack and SABOT's being clear of chamber.
- Accuracy, as indicated by:
    1. Ready rack's being: a) unlocked, b) empty, and c) designated SABOT in the load plan. (All three conditions are necessary for one correct response.)
    2. SABOT's being removed and not dropped.
- Max = 1.

PRE LDR: 1.3.1. RECALLS THAT UNLOADING IS RESPONSE TO DIFFERENCE BETWEEN AMMO IN FIRE COMMAND AND AMMO IN CHAMBER, AND SAFETY'S BEING IN FIRE, AND READY RACK'S BEING UNLOCKED

SAMPLE TEST SCENARIO

- LDR is told, "The TC has begun a fire command by saying GUNNER HEP; your main gun is loaded with SABOT, the safety switch is in SAFE, and you have unlocked a ready rack for the SABOT round"; and asked, "What do you do next?"

MEASUREMENT

- Time (in sec) between end of question and end of answer.
- Accuracy, as indicated by answering UNLOAD (or REMOVE ROUND, or equivalent) in response to the item given above.
- Max = 1.

PRE LDR: 1.3.2. RECALLS PROCEDURE FOR UNLOADING

SAMPLE TEST SCENARIO

- LDR is asked to state steps in unloading the main gun.

MEASUREMENT

- Mean time (in sec) between end of instructions and end of answer.
- Accuracy, as indicated by match between steps given by LDR and those shown on answer key.
- Max = Depends on key.

PRE LDR: 1.4. PUT UNLOADED ROUND IN READY RACK

SAMPLE TEST SCENARIO

- M60A1 or simulator is loaded with half the number of each kind of round specified in a typical (European) loading plan. All ready racks are locked. Half the racks for each kind of round are empty.
- Main gun safety is in FIRE.
- LDR is told to load one round of SABOT, and is told to study a loading plan which shows the kinds, numbers, and locations of ammo in the tank or simulator. Two hours later (more if feasible), he is told to react to the TC's (or examiner's) forthcoming fire command.
- TC (or examiner) says GUNNER SMOKE.

MEASUREMENT

- Time (in sec) between SABOT's clearing breech and SABOT's placement in ready rack.
- Accuracy, as indicated by SABOT's resting in a position that will allow rack to be locked.
- Max = 1.

PRE GNR: 1.4.1. RECALLS THAT PUTTING ROUND IN READY RACK IS RESPONSE TO UNLOADING

SAMPLE TEST SCENARIO

. LDR is told, "The TC has issued a fire command which requires you to remove a round from the chamber; your main gun safety switch is in SAFE, you have unlocked a ready rack, and removed the round from the chamber"; and asked, "What do you do next?"

MEASUREMENT

. Time (in sec) between end of question and end of answer.

. Accuracy, as indicated by answering PUT ROUND IN READY RACK (or equivalent) in response to the item given above.

. Max = 1.

PRE LDR: 1.5. LOCK READY RACK

SAMPLE TEST SCENARIO

- **M60A1 or simulator is loaded with half the number of each kind of round specified in a typical (European) loading plan. All ready racks are locked. Half the racks for each kind of round are empty.**
- **Main gun safety is in FIRE.**
- **LDR is told to load one round of SABOT, and is told to study a loading plan which shows the kinds, numbers, and locations of ammo in the tank or simulator. Two hours later (more if feasible), he is told to react to the TC's (or examiner's) forthcoming fire command.**
- **TC (or examiner) says GUNNER HEAT.**

MEASUREMENT

- **Time (in sec) between end of positioning SABOT as to allow locking rack and end of locking rack.**
- **Accuracy, as indicated by rack's being locked with SABOT in place.**
- **Max = 1.**

PRE LDR: 1.5.1. RECALLS THAT LOCKING READY RACK IS RESPONSE TO PLACING ROUND IN READY RACK

SAMPLE TEST SCENARIO

- LDR is told, "You have unlocked a ready rack, removed a main gun round from the chamber, and have put the round in the ready rack"; and is asked, "What do you do next?"

MEASUREMENT

- Time (in sec) between end of question and end of answer.
- Accuracy, as indicated by answering LOCK READY RACK in response to the item given above.
- Max = 1.

PRE LDR: 1.6. UNLOCK OTHER READY RACK[1]

SAMPLE TEST SCENARIO

- M60A1 or simulator is loaded with half the number of each kind of round specified in a typical (European) loading plan. All ready racks are locked. Half the racks for each kind of round are empty.
- Main gun safety is in FIRE.
- LDR is told to load one round of SABOT, and is told to study a loading plan which shows the kinds, numbers, and locations of ammo in the tank or simulator. Two hours later (more if feasible), he is told to react to the TC's (or examiner's) forthcoming fire command.
- TC (or examiner) says GUNNER HEP.

MEASUREMENT

- Time (in sec) between end of locking SABOT rack and end of unlocking HEP rack.
- Accuracy, as indicated by:
    1. One ready rack, designated SABOT in the load plan and formerly empty, contains a SABOT round and is locked.
    2. Another ready rack, containing a HEP round, is unlocked.
- Max = 1.

[1]"Other ready rack" means any rack containing a round like the one named in the fire command.

PRE LDR: 1.6.1. RECALLS THAT OTHER READY RACK MUST BE UNLOCKED BEFORE REMOVING NEW ROUND FOR LOADING

SAMPLE TEST SCENARIO

. LDR is told, "The TC has begun a fire command by saying GUNNER HEP; your main gun was loaded with a SABOT round, which you have removed from the chamber and locked in a ready rack"; and asked, "What do you do next?"

MEASUREMENT

. Time (in sec) between end of question and end of answer.

. Accuracy, as indicated by answering UNLOCK OTHER READY RACK (or UNLOCK HEP READY RACK, or equivalent) in response to the item given above.

. Max = 1.

PRE LDR: 1.6.2. IDENTIFIES ROUND NAMED IN FIRE COMMAND BY INSPECTION

SAMPLE TEST SCENARIO

- M60A1 or simulator is loaded with half the number of each kind of round specified in a typical (European) loading plan. Half the ready racks for each kind of round are empty.
- LDR is told that TC or examiner will give several partial fire commands, and that he (LDR) is to point to the round (in the ready rack) named in each. TC or examiner then says GUNNER SABOT TANK, and waits for LDR to point to SABOT. After LDR points to SABOT, procedure is repeated for GUNNER HEAT, GUNNER BEEHIVE, GUNNER HEP, and GUNNER SMOKE.

MEASUREMENT

- Mean time (in sec) between <u>end of instructions</u> and <u>end of each response</u>.
- Accuracy, as indicated by pointing to correct rounds in response to the instructions given above.
- Max = 5.

PRE LDR: 1.7. REMOVE ROUND LIKE ROUND IN FIRE COMMAND FROM READY RACK

SAMPLE TEST SCENARIO

- M60A1 or simulator is loaded with half the number of each kind of round specified in a typical (European) loading plan. All ready racks are locked. Half the racks for each kind of round are empty.
- Main gun safety is in FIRE.
- LDR is told to load one round of SABOT, and is told to study a loading plan which shows the kinds, numbers, and locations of ammo in the tank or simulator. Two hours later (more if feasible), he is told to react to the TC's (or examiner's) forthcoming fire command.
- TC (or examiner) says GUNNER HEP.

MEASUREMENT

- Time (in sec) between end of unlocking rack with HEP in it and end of removing the HEP round.
- Accuracy, as indicated by HEP rack's being unlocked and empty.
- Max = 1.

PRE LDR: 1.7.1. RECALLS THAT REMOVING NEW ROUND[1] TO BE LOADED IS RESPONSE TO HAVING PLACED UNLOADED ROUND IN READY RACK, AND LOCKED READY RACK, AND UNLOCKED OTHER READY RACK

SAMPLE TEST SCENARIO

- LDR is told that TC has begun a fire command which requires unloading the main gun and loading it with a new round. LDR is told that he has unloaded the gun, placed the unloaded round in the ready rack, locked that ready rack, and unlocked a rack containing the round that is to be loaded. LDR is then asked, "What do you do next?"

MEASUREMENT

- Time (in sec) between end of question and end of answer.
- Accuracy, as indicated by answering REMOVE ROUND FROM READY RACK (or REMOVE NEW ROUND, or equivalent) in response to the item given above.
- Max = 1.

[1]New round = round named in fire command = to-be-loaded round.

PRE LDR: 1.8. LOAD

SAMPLE TEST SCENARIO

- M60A1 or simulator is loaded with half the number of each kind of round specified in a typical (European) loading plan. All ready racks are locked. Half the racks for each kind of round are empty.
- Main gun safety is in FIRE.
- LDR is told to load one round of SABOT, and is told to study a loading plan which shows the kinds, numbers, and locations of ammo in the tank or simulator. Two hours later (more if feasible), he is told to react to the TC's (or examiner's) forthcoming fire command.
- TC (or examiner) says GUNNER SMOKE.

MEASUREMENT

- Time (in sec) between removal of WP round from rack and closing of breech.
- Accuracy, as indicated by empty WP rack, closed breech, and chambered WP round. (All three conditions are necessary for one correct response.)
- Max = 1.

PRE LDR: 1.8.1. RECALLS THAT LOADING IS RESPONSE TO REMOVING ROUND TO BE LOADED FROM READY RACK

SAMPLE TEST SCENARIO

- LDR is told that TC has begun a fire command which requires unloading the main gun and loading it with a new round. LDR is told that he has unloaded the gun, placed and unloaded round in the ready rack, locked that ready rack, unlocked a rack containing the round that is to be loaded, and removed the new round from the ready rack. LDR is then asked, "What do you do next?"

MEASUREMENT

- Time (in sec) between end of question and end of answer.
- Accuracy, as indicated by answering LOAD NEW ROUND (or LOAD, or PUT ROUND IN CHAMBER, or equivalent) in response to the item given above.
- Max = 1.

PRE LDR: 1.8.2. RECALLS PROCEDURE FOR LOADING

SAMPLE TEST SCENARIO

. LDR is asked to state the steps in loading the main gun.

MEASUREMENT

. Mean time (in sec) between end of instructions and end of answer.

. Accuracy, as indicated by match between steps given by LDR and those shown on answer key.

. Max = Depends on key.

PRE LDR: 1.9. STAND CLEAR

SAMPLE TEST SCENARIO

- M60A1 or simulator is loaded with half the number of each kind of round specified in a typical (European) loading plan. All ready racks are locked. Half the racks for each kind of round are empty.
- Main gun safety is in FIRE.
- LDR is told to load one round of SABOT, and is told to study a loading plan which shows the kinds, numbers, and locations of ammo in the tank or simulator. Two hours later (more if feasible), he is told to react to the TC's (or examiner's) forthcoming fire command.
- TC (or examiner) says GUNNER BEEHIVE.

MEASUREMENT

- Time (in sec) between breech's being closed and end of LDR's movement out of recoil "envelope."
- Accuracy, as indicated by closed breech, chambered BEEHIVE round, and LDR's standing outside recoil envelope. (All three components constitute one correct response.)
- Max = 1.

PRE LDR: 1.9.1. RECALLS THAT STANDING CLEAR IS RESPONSE TO LOADING, AND DONE BEFORE PLACING SAFETY IN FIRE AND SAYING UP

SAMPLE TEST SCENARIO

. LDR is asked,

1. "What do you do immediately after loading the main gun?"
2. "Do you stand clear before or after placing the safety in FIRE and saying UP?"

MEASUREMENT

. Mean time (in sec) between end of questions and end of answers.

. Accuracy, as indicated by answering STAND CLEAR OF BREECH (or STAND CLEAR, or equivalent) in response to Item 1 above, and answering BEFORE in response to ITEM 2.

. Max = 2.

PRE LDR: 2.0. PLACE SAFETY IN FIRE

SAMPLE TEST SCENARIO

- M60A1 or simulator is loaded with half the number of each kind of round specified in a typical (European) loading plan. All ready racks are locked. Half the racks for each kind of round are empty.
- Main gun safety is in SAFE.
- LDR is told to load one round of SABOT, and is told to study a loading plan which shows the kinds, numbers, and locations of ammo in the tank or simulator. Two hours later (more if feasible), he is told to react to the TC's (or examiner's) forthcoming fire command.
- TC (or examiner) says GUNNER HEAT.

MEASUREMENT

- Time (in sec) between breech's being closed and closing main gun safety switch.
- Accuracy, as indicated by closed breech, chambered round, LDR's standing outside recoil envelope, and safety's being in FIRE. (All four components constitute one correct response.)
- Max = 1.

PRE LDR: 2.0.1. RECALLS THAT PLACING SAFETY IN FIRE IS RESPONSE TO LOADING AND STANDING CLEAR

SAMPLE TEST SCENARIO

- LDR is told, "You have loaded the main gun and are standing clear of the breech"; and asked, "What do you do next?"

MEASUREMENT

- Time (in sec) between end of question and end of answer.
- Accuracy, as indicated by answering PUT SAFETY IN FIRE to the item given above.
- Max = 1.

PRE LDR: 2.1. SAY UP

SAMPLE TEST SCENARIO

- M60A1 or simulator is loaded with half the number of each kind of round specified in a typical (European) loading plan. All ready racks are locked. Half the racks for each kind of round are empty.
- Main gun safety is in FIRE.
- LDR is told to load one round of SABOT, and is told to study a loading plan which shows the kinds, numbers, and locations of ammo in the tank or simulator. Two hours later (more if feasible), he is told to react to the TC's (or examiner's) forthcoming fire command.
- TC (or examiner) says GUNNER BEEHIVE.

MEASUREMENT

- Time (in sec) between main gun safety switch's being closed and LDR's saying UP.
- Accuracy, as indicated by safety's being in FIRE, and by saying UP. (Both components constitute one correct response.)
- Max = 1.

PRE LDR: 2.1.1. RECALLS THAT SAYING UP IMMEDIATELY FOLLOWS PLACING MAIN GUN SAFETY IN FIRE

SAMPLE TEST SCENARIO

- LDR is told, "You have loaded the main gun, are standing clear of the breech, and have placed the main gun safety in FIRE"; and asked, "What do you do next?"

MEASUREMENT

- Time (in sec) between end of question and end of answer.
- Accuracy, as indicated by answering SAY UP in response to the item given above.
- Max = 1.